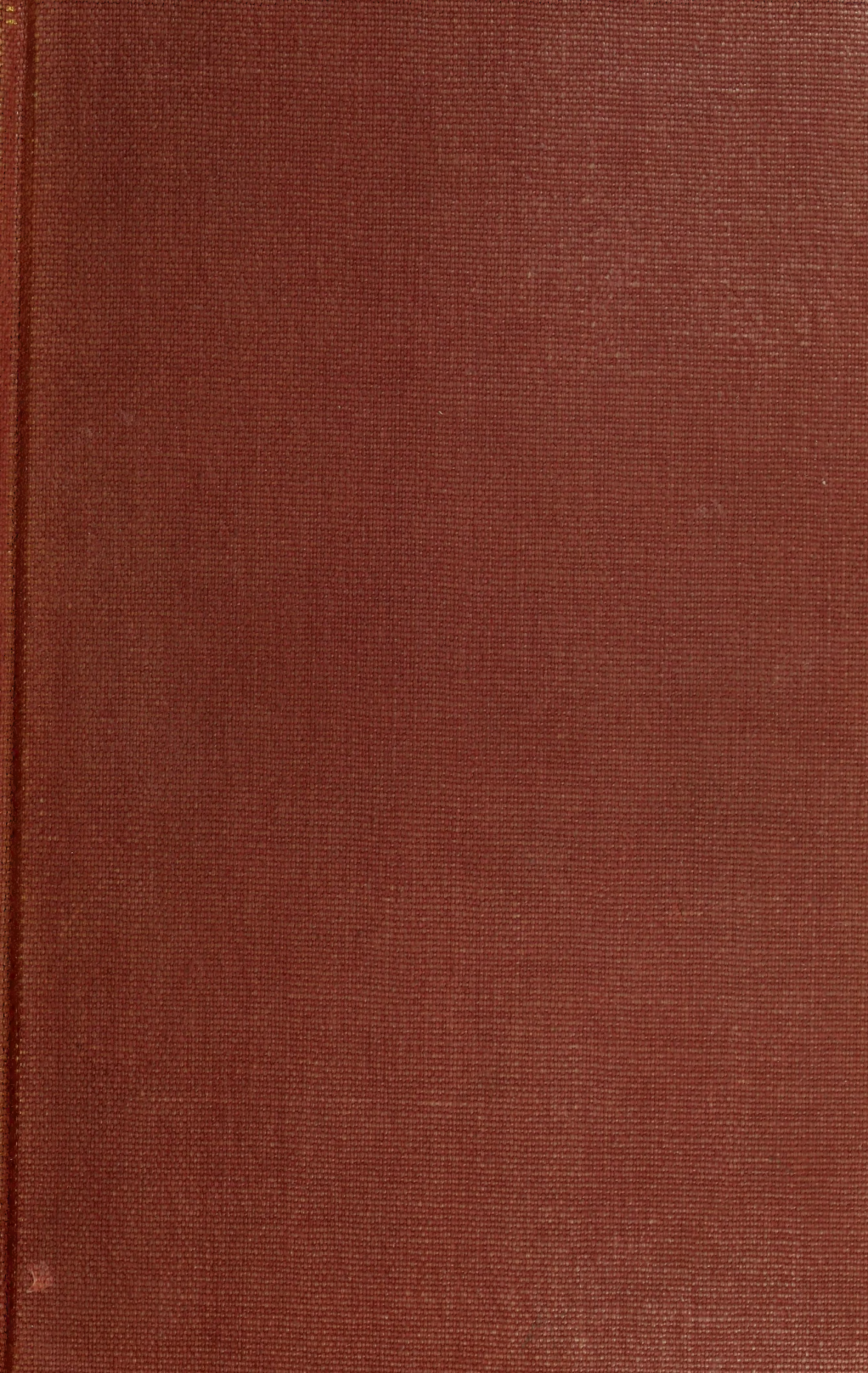


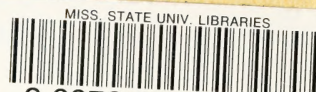


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AN *Illustrated Guide* TO

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Identification

and Landscape Uses of

Mississippi Native Shrubs

NO. 369-392

BULLETIN, NO. 369

JULY, 1942

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION

CLARENCE DORMAN, Director

STATE COLLEGE, MISSISSIPPI

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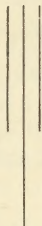
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An Illustrated Guide to
Identification and Landscape Uses
of
Mississippi Native Shrubs



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Associate in Horticulture
Mississippi Experiment Station

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An Illustrated Guide To Identification and Landscape Uses *of* Mississippi Native Shrubs

By F. S. BATSON

Mississippi abounds in native shrubs that are adapted to landscape plantings. Most of them are rarely used in the state. During the past few years there has been a decided increase in interest in the native plants of Mississippi, but many people who have wanted to use them have been handicapped in not being able to identify native plants in the woods and use them properly in the landscape.

This bulletin has been prepared to help nature lovers, nurserymen and gardeners to know more of the native plants and how each can be used effectively in various landscape plantings. Although it is realized that this bulletin does not list and describe all of the native shrubs worthy of use in the landscape, the inquiries that have been received indicate that even an incomplete list at this time will be of value to many. It is hoped that in the future more plants can be added, making a more complete inventory of the native shrubs in various sections of the state.

CONSERVATION

Many people of Mississippi consider native shrubs as worthless, but these same plants are much valued in other sections of the country. In general, people do not realize that such a wealth of native material exists in the state. A few species of plants such as wild azalea, dogwood, holly, and mountainlaurel—plants that are striking in appearance and recognized by most people as being attractive—are frequently abused by tearing off the branches to get a few blooms that quickly wilt. Plants are often improperly dug, tied on the front bumper of the automobile without protection against drying wind on the roots, only to die when set out. In some cases it may be advisable to transplant shrubs from the woods, but respect for the rights of others as well as the beauty of roadsides and farmsteads should be considered. If shrubs are to be dug from the woods, it should be done in areas that are not frequently visited, and only after permission has been obtained from the landowner. Promiscuous removal from woods and roadsides is a kind of depredation that should not be tolerated.

Plants grown in the nursery are much more desirable and usually less expensive, particularly where poor transplanting methods are employed.

DISTRIBUTION OF PLANTS

Climate and soils largely determine the distribution of plants; hence only a few of the plants described are well distributed throughout the State. The sections of the state where the various species of plants are found have been indicated by the soil areas. See map, page 8. This information is incomplete and it is realized that many of the plants grow in areas not indicated, since the entire state has not been canvassed extensively. Information as to location of various shrubs in the State has been taken from E. N. Lowe's "Plants of Mississippi" and the author's notes.

BOTANICAL DESCRIPTIONS AND PLANT NAMES

Botanical descriptions of plants have been taken from or simplified from the following publications:

Cyclopedia of Horticulture, by L. H. Bailey;

Manual of Botany, by Asa Gray;

Southern Wild Flowers and Trees, by Alice Loundsberry;

Winter Botany, by William Trelease;

Manual of Southeastern Flora, by J. K. Small.

Information as to use of native shrubs for wildlife was taken from U. S. D. A. Miscellaneous Publication No. 303, "Native Woody Plants of the United States."

"Standardized Plant Names", Second Edition, was used in naming the plants. "Gray's Manual of Botany" was used when plants were not listed in "Standardized Plant Names". Synonyms for common names are shown in italics.

KEY TO SOME OF THE COMMON ORNAMENTAL SHRUBS, VINES, AND SMALL TREES NATIVE OF MISSISSIPPI

The following key has been prepared only for the plants described in this bulletin. The descriptive terms used will, in most instances, require no explanation. Those who have had no special training in botany will be able to use the key since it is based on prominent and distinctive characteristics which can be readily observed.

To use the key, examine the leaf, and determine in which of the seven sections shown below the plant belongs. Then turn to the section to which the leaf belongs, and from the descriptions given under each section determine the name of the plant.

GENERAL KEY

	Section
Shrub or tree with small scalelike, narrow, evergreen leaves.....	I
Shrubs, small trees or vines with broad leaves:	
Leaves simple (single leaves)—	
Leaves alternately attached to twigs—	
Edges of leaves toothed	II
Edges of leaves not toothed	III
Leaves attached opposite on twigs—	
Edges of leaves toothed	IV
Edges of leaves not toothed	V
Leaves compound (several leaflets)—	
Leaves alternately attached to twigs	VI
Leaves opposite on twigs	VII

SPECIFIC KEY

I. Small scalelike evergreen leaves with spiny tips.

Shrubs or trees with bark reddish brown shredding in long strips Eastern Redcedar, Page 33.

II. Leaves simple, alternate, with edges toothed.

A. Leaves evergreen—

1. Fruits with soft pulpy material covering the seed—

(a). Edges of leaves toothed only above the middle; fruits black during fall and winter—

(x). Leaves usually widest above the middle; small spine not present at tip of leaves Inkberry, Page 27.

(y). Leaves usually widest near middle; teeth along edge of leaves in form of small spines; small spine usually present at tip of leaves Swamp Gallberry, Page 29.

(b). Leaves with teeth along entire edges; fruit red in fall and winter—

(x). Teeth along edge in the form of sharp spines; leaves 1½ to 4 inches long.....American Holly, Page 29.

(y). Teeth along edges rounded; leaves ½- to 1-inch long.....Yaupon, Page 31.

2. Fruits waxy grayish color; leaves yellowish-green color, twigs with spicy odor when bruised.....

Southern Waxmyrtle, Page 39.

3. Fruits hard, not covered with pulpy or waxy material; leaves 2 to 4 inches long, dark green above, pale beneath, edges slightly toothed along entire margin.....

Coast Leucothoe, Page 35.

B. Leaves deciduous, shedding in autumn—

1. Underside of leaves pubescent (small hairs) at least along midrib—

(a). Fruits resembling a small pine cone; small brown hairs along midvein on under side of leaves.....

Hazel Alder, Page 9.

(b). Fruits not resembling a small pine cone—

(x). Plants grow to a height of not more than 3 feet Jersey Tea Ceanothus, Page 15.

(y). Plants grow to a height of more than 3 feet—

(1) Leaves often 4 inches long; flowers 3 to 4 inches across.....Virginia Stewartia, Page 47.

(2) Leaves never 4 inches long; flowers 1/3- to ½-inch across.....Red Chokeberry, Page 11.

2. Under side of leaves not pubescent. (Some kinds of hawthorn exception)

(a). Plants with yellow orange or red fruits in autumn—

(x) Twigs rather slender, flowers usually ¼- to ¾-inch across Hawthorn, Page 21.

(y) Twigs stout, flowers 1-inch across..... Southern Crab, Page 37.

(b). Plants do not produce yellow, orange, or red fruits—

(x) Twigs and racemes of flowers or fruits covered with small hairs; racemes 2 to 6 inches long Virginia Sweetspire, Page 33.

(y) Twigs and racemes of flowers or fruits without small hairs; racemes 2 to 4 inches long Sweetbells Leucothoe, Page 35.

III. Leaves simple, alternate, without teeth along edges—

A. Leaves evergreen—

1. All leaves with distinct, alternate arrangement on twigs—
 - (a). Plant, a vine.....**Laurel Greenbriar**, Page 47.
 - (b). Plant, a shrub or small tree—
 - (x) Flowers or fruits borne in panicles only at ends of branches.....**Buckwheat tree**, Page 17.
 - (y) Flowers or fruits borne in panicles mostly arising in the axils of the leaves—
 - (1) Twigs prominently angled.....**Fetterbush Lyonia**, Page 37.
 - (2) Twigs rounded or somewhat 3-sided.....**American Cyrilla**, Page 21.
2. Many leaves, especially terminal clusters not distinctly alternate but often appearing to be whorled—
 - (a). Leaves rosin scented, flowers red with odor of decaying fish.....**Florida Anisetree**, Page 31.
 - (b). Leaves not rosin scented, flowers in clusters, light pink to white with purple markings.....**Mountainlaurel Kalmia**, Page 33.

B. Leaves deciduous, shedding in autumn—

1. Leaves variously shaped, often 2 inches or more in width—
 - (a). A vine.....**Carolina Snailseed**, Page 19.
 - (b). A shrub or small tree.....**Common Sassafras**, Page 45.
2. Leaves rather uniformly shaped, less than 2 inches wide—
 - (a). Plants produce edible fruits.....**Huckleberry**, Page 23.
 - (b). Plants do not produce edible fruits—
 - (x) Pink or white trumpet shaped flowers; twigs rather straight, often with leaves only at the ends of twigs.....**Pinksterbloom Azalea**, Page 43.
 - (y) Flowers white with yellow stamens; twigs zig-zagged; leaves closely, regularly spaced on branches.....**American Snowbell**, Page 49.

IV. Leaves simple, opposite, deciduous with toothed edges—

A. Flowers and fruits produced only at ends of twigs—

1. Leaves lobed, dense white hairs beneath, long petioles.....**Oakleaf Hydrangea**, Page 25.
2. Leaves not lobed, without dense hairs beneath, short petioles—
 - (a). Leaves finely, sharply toothed, end of leaves often rounded, 1½ to 4 inches long.....**Nannyberry Viburnum**, Page 51.
 - (b). Leaves obscurely toothed, ends of leaves distinctly pointed, young leaves scurfy on both sides, 2 to 6 inches long.....**Possumhaw Viburnum**, Page 51.

B. Flowers and fruits produced at axils of leaves—

1. Leaves often more than 4 inches long.....**American Beautyberry**, Page 13.
2. Leaves not more than 4 inches long—
 - (a). Fruit borne in "pods" that open in early fall exposing red seed; twigs bright green.....**Brook Euonymus**, Page 23.
 - (b). Fruits borne singly on stem; twigs light gray.....**Possumhaw**, Page 27.

V. Leaves simple, opposite, without toothed edges—**A. Leaves evergreen—****1. A vine—**

- (a). Flowers borne only at ends of twigs, red, trumpet-shaped with yellow throat.....**Trumpet Honeysuckle**, Page 35.
 (b). Flowers borne mostly in axils of leaves, trumpet-shaped, bright yellow.....**Carolina Jessamine**, Page 25.

2. A shrubby plant—

- (a). Flowers borne on ends of twigs only.....**Witherod Viburnum**, Page 49.
 (b). Flowers borne mostly in axils of leaves.....**Devilwood Osmanthus**, Page 39.

B. Leaves deciduous, shedding in autumn—

1. Leaves, twigs, and flowers sweet scented when bruised. (Odor similar to strawberries).....**Common Sweetshrub**, Page 13.

2. Leaves, twigs, and flowers not sweet scented when bruised—**(a). Fruits with fleshy or pulpy material covering seeds—**

- (x) Leaves usually 6 to 8 inches long.....**White Fringetree**, Page 17.

- (y) Leaves less than 2 inches long.....**Indiandurrant Coralberry**, Page 49.

(z) Leaves 2 to 5 inches long—

- (1) Leaves rough on upper side, small hairs beneath.....**Roughleaf Dogwood**, Page 19.

- (2) Leaves smooth above, smooth underneath except few small hairs on midvein.....**Flowering Dogwood**, Page 21.

(b). Fruits without fleshy or pulpy material covering the seed—

- (x) Fruits, dry pods 2½ to 3½ inches long; leaves heart-shaped.....**Eastern Redbud**, Page 17.

- (y) Fruit, a rough ball composed of closely packed long seeds; leaves somewhat oval with long pointed tip.....**Common Buttonbush**, Page 15.

VI. Leaves compound, alternate—**A. Stems coarse, stout, with milky sap—**

1. Rachis (leaf stem) winged.....**Flameleaf Sumac**, Page 41.

2. Rachis not winged

- (a). Ends of twigs covered with dense velvety hairs.....**Staghorn Sumac**, Page 43.

- (b). Ends of twigs smooth, without hairs.....**Smooth Sumac**, Page 41.

B. Stems rather slender, sap not milky—

1. Leaves palmate (hand-like).....**Virginiancreeper**, Page 39.

2. Leaves pinnate (feather-like)—

- (a). Usually 5, rarely 7 leaflets.....**Carolina Rose**, Page 45.

- (b). Eleven to twenty-five leaflets.....**Indigobush Amorpha**, Page 11.

VII. Leaves compound, opposite—

- A. A vine.....Common Trumpetcreeper**, Page 15.

B. A shrubby plant—

1. Leaves palmate (hand-like) with 5 to 7 leaflets.....**Red Buckeye**, Page 9.

2. Leaves pinnate (feather-like) with 5 to 11 leaflets.....**American Elder**, Page 45.

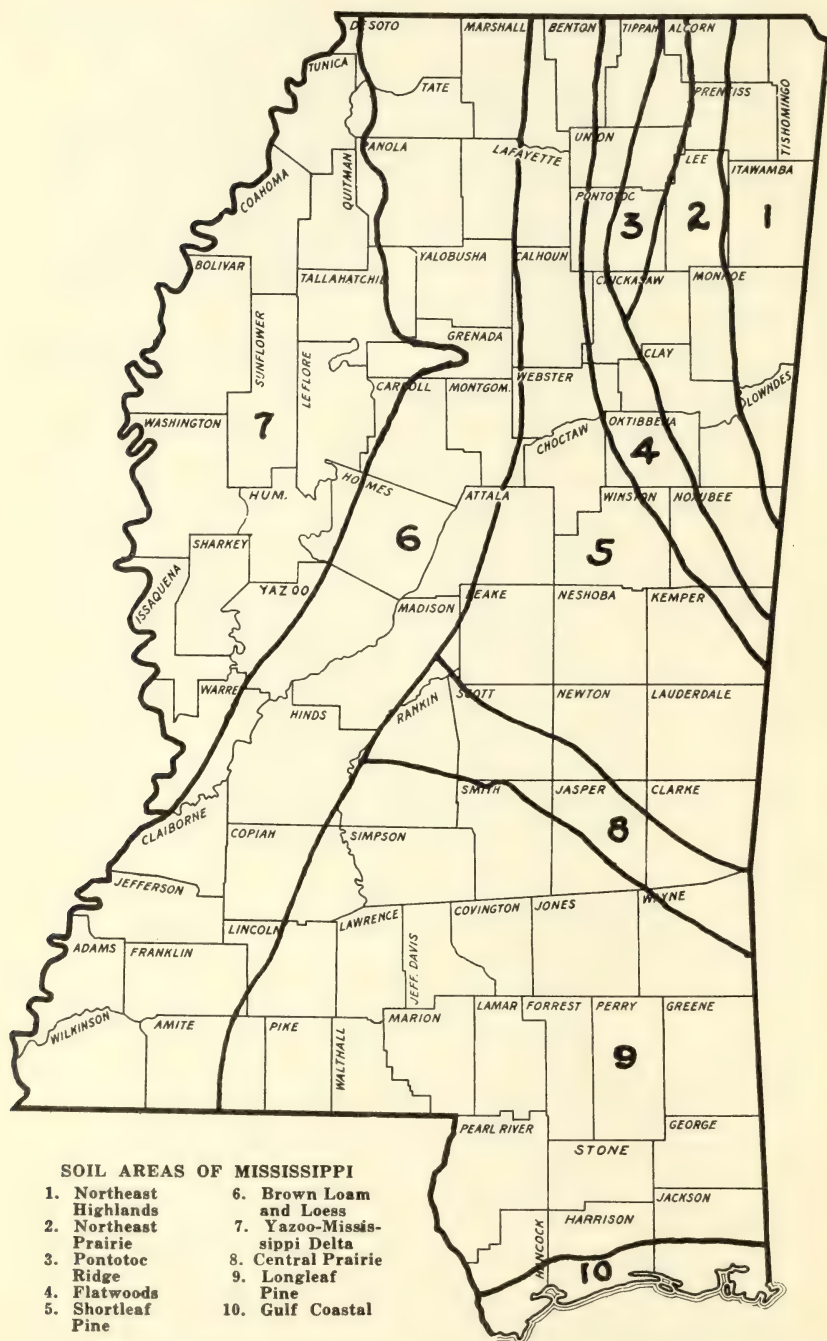


Figure 1

DESCRIPTION OF PLANTS

RED BUCKEYE

Aesculus pavia

A coarse-textured deciduous shrub which usually grows to a height of 4 to 10 feet, occasionally higher. Found in open woods, bottom land, swamps, and stream banks, in sunny and shady situations. Widely distributed through the state in areas 2, 4, 5, 6, and 8. See map, page 8. Attractive dark green coarse foliage and large clusters of red blooms in early spring. The dark red flowers of buckeye appear when the bearded iris bloom. The combination of red of the buckeye and purple and white of the iris is excellent. Landscape uses include borders, groups, and roadside plantings. Plants are said to be poisonous to livestock if eaten.



Figure 2—Red Buckeye

Form: rather spreading, somewhat sparingly branched. **Leaves** opposite, dark green, palmate, usually 5 to 7 leaflets, 3 to 6 inches long, margins finely toothed. **Flowers** purplish dark red in panicles 4 to 8 inches long in April; persistent, lasting 4 to 6 weeks. **Twigs** stout, rounded; pith large, rather 6-sided, continuous, pale.

HAZEL ALDER, *Smooth-Alder*

Alnus rugosa

A rather coarse-textured, widely distributed, deciduous shrub which holds its leaves late in the fall. Although it sometimes reaches a height of 30 feet, it is more typically shrubby in nature. Found more often in wet or moist places, making dense thickets



Figure 3—Hazel Alder



Figure 4—Indigobush Amorpha

around pools and streams; however, it is adapted also to well-drained soil. Plants thrive well in sunny or shady places. Alder is particularly interesting in appearance during the winter months when the catkins and cones are conspicuous. Distributed throughout the state, it seems to flourish with little care and is excellent for highway mass plantings. Also it may be used in borders, groups, and screens.

Form: spreading, compact. **Leaves** alternate, prominently veined, thickish, $1\frac{1}{2}$ to 4 inches long, leaf margins with minute teeth, often with rusty small hairs along veins underneath. **Flowers**, yellowish-brown catkins, appear in February and March. Old "cones" borne in clusters somewhat resembling a miniature pine cone, usually remain on plants during winter. See figure 3. **Twigs** usually 3-sided, dark grayish, rather coarse, buds distinctly stalked; pith small, 3-sided, continuous.

INDIGOBUSH AMORPHA, *False Indigo*

Amorpha fruticosa

A rather coarse deciduous shrub with interesting foliage. Usually grows 5 to 10 feet high, occasionally higher. Found in swamps and along banks of streams, in either sun or shade. Distributed through the state in areas 2, 4, 5, 6, 7, 9, 10, and perhaps others. See map, page 8. Plants are adapted to a wide range of soils and grow very rapidly when cultivated. Useful in borders, groups, parks, and roadsides, especially along road banks when used behind some other shrub.

Form: ascending, sparingly branched. **Leaves** alternate, compound; 11 to 25 leaflets, which are oval, $\frac{1}{2}$ to $1\frac{1}{2}$ inches long. **Flowers** dark purplish-violet in masses of dense panicles 3 to 6 inches long borne at the ends of branches during April and May. **Seeds** borne in pods, usually much curved, conspicuously marked with amber colored raised glands. **Twigs** rather slender, slightly angled below the nodes; pith moderate size, roundish, continuous, white.

RED CHOKEBERRY

Aronia arbutifolia

A shrub that is valuable for its attractive leaves that color up in the fall, and particularly for its bright red berries that stay on the plant for several months. A deciduous shrub which grows to a height of 6 to 10 feet. Usually found in bogs and lowland around bodies of water in acid soil. Occurs in sun or shade in areas 1, 5, 6, 9, and 10. More common in southern part of state. See map, page 8. May be used in borders, groups, bog gardens, and roadside plantings. Relatively easy to transplant.

Form: upright, somewhat loosely branched. **Leaves** alternate, oval, abruptly short pointed at apex, 1 to 3 inches long, margins toothed, dark green above; grayish, fine, dense hairs beneath. **Flowers** white or purplish tinged, $\frac{1}{3}$ - to $\frac{1}{2}$ -inch across in March and April. **Fruits** bright or dull red about $\frac{1}{4}$ -inch across in fall and early winter. **Twigs** moderately slender, roundish, smooth, brown.



Flower



Fruit

Figure 5—Red Chokeberry**Figure 6—American Beautyberry**

AMERICAN BEAUTYBERRY, *French Mulberry**Callicarpa americana*

This shrub will add beautiful touches of reddish-violet color to the fall and winter garden. A fast growing deciduous shrub which grows to a height of 4 to 8 feet. Found in woods, thickets, hammocks, and pinelands growing in moist, well-drained, or very dry soil. It is suitable for planting in sunny or shady places; however, it appears to be best suited for sunny places. Occurs in parts of areas 3, 4, 5, 6, 9, 10, and perhaps others. See map, page 8. Relatively easy to transplant. Useful in borders, groups, parks, wild gardens, and roadside masses. Fruiting is much heavier when brought into cultivation. Fruits are eaten by several species of birds.

Form: spreading, rather loosely branched. **Leaves** opposite, 3 to 6 inches long, prominent veins, relatively long petioles, margins toothed, small hairs beneath. **Flowers** small, bluish, borne in clusters at the axils of the leaves in May and June. **Fruits** violet or lilac-violet, soft and juicy, produced in compact clusters at axils of leaves during late summer and fall. **Twigs** moderately slender, soft, roundish or obscurely 4-sided, more or less covered with scurfy small hairs; pith relatively large, rounded, white, continuous.

COMMON SWEETSHRUB

Calycanthus floridus

Figure 7—Common Sweetshrub

Often found in cultivation around the homes of early settlers where it was planted for its spicy odor when flowers, stems, and leaves were bruised; however, it is a native of the State in area 1 and perhaps others. See map, page 8. A deciduous shrub which grows to a height of 3 to 6 feet. Found in rich woods and on hillsides and stream banks in sunny or shady places. Fertile acid soil is required for best growth. Useful in borders, groups, foundation plantings, wild gardens, parks. Easily transplanted.

Form: upright stems with spreading branches. **Leaves** opposite, 2 to 4 inches long, oval, long pointed, prominent veins, dark green above, pale green beneath, margins smooth. **Flowers** dark reddish brown, about 2 inches across, produced in axils of leaves during April. Fragrant when bruised. **Twigs** moderately slender, sparingly branched; pith relatively large, somewhat 6-sided.



Figure 8—Common Trumpet creeper



Figure 9—Jersey Tea Ceanothus



Figure 10—Common Buttonbush

COMMON TRUMPETCREEPER, *Cow-itch Vine**Campsis radicans*

A deciduous fast-growing vine found throughout the State. It grows in sun or shade, on upland and bottom soil, and often becomes a pest in cultivated land. Used on walls, fences, pergolas, and roadside banks. Its introduction into landscape plantings is usually not advisable since the plants often spread rapidly and become a pest that is very difficult to eradicate.

Form: trailing or climbing vine. **Leaves** opposite, compound, 8 to 12 inches long; leaflets 7 to 11, 1 to 2½ inches long, thin, coarsely toothed. **Flowers** reddish-orange, trumpet shaped, 2 to 3½ inches long, produced in terminal clusters during several months of summer. **Seed pods** brownish, 6 to 9 inches long produced in terminal clusters. **Twigs** somewhat slender capable of producing aerial roots that cling to wood or masonry structures.

JERSEY TEA CEANOTHUS, *Red-Root**Ceanothus americanus*

A useful, small, deciduous shrub which grows to a height of 1½ to 3 feet; suitable for small gardens. Usually found in dry woodlands in sunny or shady situations. Distributed through many parts of the State in areas 3, 4, 5, 6, 9, and probably others. See map, page 8. May be used in borders, groups, and foundation plantings. Suitable for use on dry banks.

Form: spreading, fairly compact. **Leaves** alternate, 1½ to 3 inches long, paler green beneath; edges finely, irregularly toothed. **Flowers** white, borne in clusters at ends of branches; appear in May and June. **Twigs** green or brownish, rounded, rather slender; pith relatively large, white, continuous. **Roots** dark red, used for medicinal purposes.

COMMON BUTTONBUSH, *Buttonwillow**Cephalanthus occidentalis*

The attractive showy white flowers, produced over a long season, and the rich glossy foliage are worthwhile characteristics of Common Buttonbush. A vigorous growing, rather coarse, deciduous shrub which usually grows to a height of 6 to 12 feet, occasionally higher. It is native throughout the State, found in sun or shade along the edges of marshes, pools, and streams; however, it will grow in well-drained soil. Easily transplanted; cuttings root readily. Plants may be used in borders, groups, and along roadsides.

Form: spreading, openly branched. **Leaves** opposite, oval, long pointed, 3 to 6 inches long, glossy above, smooth margins. **Flowers** white, ball-shaped, about 1-inch in diameter, appear in groups of three or more at the ends of branches from June to September. Flower heads often remain on plants during winter. **Twigs** reddish, glossy, rather slender, rounded; pith small, light brown, more or less 4-or 6-sided.



Figure 11—Eastern Redbud



Figure 12—White Fringetree

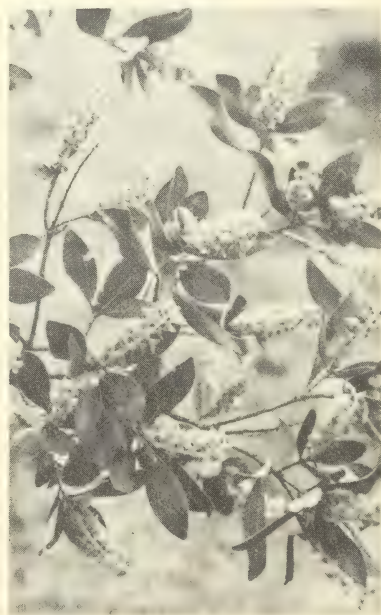


Figure 13—Buckwheat tree

EASTERN REDBUD, *Judas-Tree**Cercis canadensis*

The redbud furnishes the first color motif in the spring woods from Canada to the Gulf. A popular, widely distributed shrub or small tree which attains a height of 20 to 40 feet. Commonly found in dry rich woods; more abundant on soils with high lime content. It is best suited for sunny situations. Found in all sections of Mississippi except the Gulf Coastal area. May be used for plantings in borders, parks, streets, and roadsides. Small plants fairly easily transplanted.

Form: upright stems with spreading branches. **Leaves** opposite, heartshaped, 3 to 5 inches long, dark green above, grayish beneath, smooth margins. **Flowers** pink-purple, borne in clusters along twigs and larger branches, petals approximately $\frac{1}{2}$ -inch long. **Seeds** borne in pods $2\frac{1}{2}$ to $3\frac{1}{2}$ inches long. **Twigs** moderately slender, zig-zagged, bark smooth, heartwood brown.

WHITE FRINGETREE, *Grandsir Graybeard**Chinonanthus virginicus*

Before the leaves fully unfold in the spring, the misty blooms of graybeard waving in the spring breezes bring many expressions of desire to take up a plant and carry it to the back yard where it will likely grow into a much more handsome plant. This shrub or small tree which grows to a height of 20 to 30 feet is hardy throughout the State. It is found usually in swampy woods and stream banks in acid soil. Plants are well distributed through the State in areas 1, 5, 8, 9, 10, and perhaps others. See map, page 8. Growing in sunny or shady situations it is adapted to many landscape uses such as borders, groups, parks, roadside masses, and wild gardens. Produces a tap root, making it difficult to transplant. It should be moved when very small.

Form: spreading branches, sparingly branched. **Leaves** opposite, dark green, 4 to 8 inches long, with margins smooth. **Flowers** delicate, white, in loose drooping clusters during late March and April. **Fruit** bluish-black about $\frac{1}{2}$ -inch in diameter, borne in clusters, ripen in September and October. Said to be a favorite food of wild turkeys. **Twigs** rather stout, sparingly branched, light gray, smooth bark.

BUCKWHEATTREE, *Titi, Ironwood**Cliftonia monophylla*

An evergreen shrub or small tree which grows to a height of 6 to 25 feet. Thrives best in moist, sandy, peaty soils exposed to full sun. Found in areas 9 and 10. See map, page 8. Particularly well adapted for plantings in poorly-drained places; however, it thrives in well-drained soil. May be used in borders, groups, screens, and roadside plantings. Attracts insects, especially the honey bee while in bloom.



Figure 14—Carolina Snailseed



Figure 15—Roughleaf Dogwood

Form: rather upright, fairly compact. **Leaves** alternate, oval, thickish, $1\frac{1}{2}$ to 2 inches long, paler beneath, margins smooth. **Flowers** small, fragrant, pinkish-white, borne in panicles $\frac{3}{4}$ to $3\frac{1}{4}$ inches long on the ends of the twigs during March and April. **Fruits** in clusters following the flowers, three to four wings, resemble buckwheat. See figure 13. **Twigs** grayish, rather slender.

CAROLINA SNAILSEED

Coral-beads, Carolina-moonseed, Red-moonseed, Scarletberry
Cocculus carolinus

An unusually attractive vigorous growing deciduous vine grown for its profusion of red fruits in the fall and handsome foliage. Found in woods, fields, and thickets in sunny or shady situations. It occurs abundantly in areas 1, 2, 4, 7, and perhaps other parts of the State. See map, page 8. Plants can be transplanted from the woods, grown from root divisions or seeds. Useful on trellises, woven wire fences, and other structures on which it may cling by its tendrils. It will not climb on wood or masonry walls.

Form: rather thick growing vine. **Leaves** alternate, $1\frac{1}{2}$ to 4 inches long, smooth margins, vary greatly in shape from ovate to deltoid. **Flowers** white, small, in clusters during late spring. **Fruits** in dense clusters, bright red, conspicuous during fall months. **Twigs** twining, rounded, fluted, rather slender, dark green; pith white, relatively large.

ROUGHLEAF DOGWOOD

Cornus asperifolia

The dogwood family is large and varied. The roughleaf dogwood is not as showy as the flowering dogwood, but it has a definite place in the native shrub border. A deciduous shrub which grows to a height of 8 to 15 feet. Found in bottom land and dry limestone hillsides in areas 2, 4, and 6. See map, page 8. Although it will tolerate shady situations, it is more often found exposed to full sun. It may be used in borders, groups, and roadside plantings. Foliage turns red in fall of year. There are several other species of shrub dogwoods found in various areas in the State that may be used similarly to roughleaf dogwood in landscape plantings.

Form: upright stems, spreading branches. **Leaves** opposite, 2 to 4 inches long, ovate, rough above, and margins smooth to undulate. **Flowers** white, small, and borne in clusters at the ends of twigs during May and June. **Fruit** white, approximately $\frac{1}{4}$ -inch in diameter borne in rather loose clusters. **Twigs** moderately slender, brownish color.

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Figure 16—Flowering Dogwood



Figure 17—Hawthorn

FLOWERING DOGWOOD

Cornus florida

A well known, slow-growing, deciduous shrub or small tree that occurs so abundantly over the State that its rare beauty is often overlooked. Its profusion of blooms in spring, and striking red foliage in the fall followed by red fruits during winter, qualify this plant as one of the most attractive native plants in America. Found on dry hills and rich bottom land, usually in full sun. It occurs in areas 1, 3, 4, 5, 6, 8, 9, and 10. See map, page 8. Useful in borders, groups, parks, streets, wild gardens, and roadside plantings. Plants shallow rooted, rather difficult to transplant. Preferably plants should be grown in the nursery and transplanted with a ball of earth around the roots.

Form: upright trunk with spreading branches. Leaves opposite, 3 to 5 inches long, dark green above, smooth margins, prominent veins. **Flowers** composed of four white bracts (occasionally pink form is found) notched at apex, yellow center, 3 to 4 inches broad, March and April. **Fruit** borne in clusters at the ends of branches, bright red during fall and winter. **Twigs** rather slender.

HAWTHORN, *Haw**Crataegus* species

One of the well-known shrubs or small trees found in all parts of the State, but because of the difficulty of identifying the various species, only the general character of this group of plants is described. Deciduous plants which usually grow 10 to 25 feet in height. Found in all parts of the State in a wide range of soil conditions. Suitable for sunny or shady places. Due to the fact that plants often form long tap roots, this group is usually difficult to transplant. Useful for borders, groups, specimen, and roadside plantings.

Form: usually upright stems with spreading branches. **Leaves** alternate, simple, variable in size and shape. **Flowers** in terminal clusters, white or pink, five petals, borne in early spring. **Fruit** of these plants attractive, varying in color: yellow, orange, red, blue, or black; but more often orange or red. **Branches** usually rather slender, often armed with thorns or spines; bark often scaly, gray to brownish color.

AMERICAN CYRILLA, *Black Titi*, *Leatherwood**Cyrilla racemiflora*

A semi-evergreen shrub or small tree sometimes attaining a height of 35 feet. Usually found in lowland in the edge of swamps and along stream banks in areas 9 and 10. See map, page 8. Adapted to well-drained or poorly-drained soil, in sunny or shady places. May be used in borders, groups, and roadside plantings.



Figure 18—American Cyrilla



Figure 19—Brook Euonymus



Figure 20—Huckleberry

Form: much branched, spreading. **Leaves** alternate, shiny, thick, yellowish-green, 2 to 4 inches long, smooth margins. **Flowers** white, produced in clusters of slender racemes 4 to 6 inches long during June. **Fruit** in long racemes. See figure 18 showing partially mature fruits. **Twigs** rather slender, straw colored, somewhat 3-sided.

BROOK EUONYMUS, *Strawberrybush*

Euonymus americanus

The Brook Euonymus creates somewhat of a sensation in the garden in the fall when it is full of fruit. A deciduous shrub which grows to a height of 3 to 6 feet and has brilliant red or orange-red foliage and attractive fruits in fall. Usually found in fertile woods, bluffs, and hammocks in shady or sunny places. Particularly well adapted for plantings in dense shade. Hardy throughout State. Found in areas 1, 5, 6, 9, and perhaps others. See map, page 8. In landscape plantings it may be used in borders, foundation plantings, groups, and roadside plantings. Easily transplanted bare-rooted from woods. Seeds eaten by a few species of birds.

Form: upright stems or sometimes stems trailing and rooting at nodes, making dense clumps. Leaves opposite, 1 to 4 inches long, almost no petiole, bright green, rather thin, margins rounded toothed. **Flowers** small, greenish purple, inconspicuous. **Seed pods** ripen in September and October exposing the scarlet seed and the inside of the seed pods which are rough and warty, resembling a strawberry. **Twigs** slender, rounded, bright green.

HUCKLEBERRY

Gaylussacia species

A shrub which should be grown more extensively for its fine textured foliage and attractive edible fruit. Because of the difficulty of identifying the various species, only the general characteristics of the huckleberries are discussed. Both evergreen and deciduous plants usually grow to a height of 2 to 6 feet, occasionally higher. Found in woods, thickets, open woods, and swamps in moist, acid soil. Grows in nearly all the hill section of the State in sunny and shady situations where the soils are acid. Relatively easily transplanted. Useful in borders, groups, foundation plantings, bird gardens, and hedges. Plantings should be attempted only on acid soil.

Form: rather spreading, usually much branched. **Leaves** alternate, relatively small, with smooth edges. **Flowers** small, tubular or bell-shaped, white, greenish or reddish in early spring. **Fruits** blue or black, edible. **Twigs** slender, roundish.



Figure 21—Carolina Jessamine



Flower



Winter Character

Figure 22—Oakleaf Hydrangea

CAROLINA JESSAMINE, *Yellow Jessamine**Gelsemium sempervirens*

A niagara of yellow blossoms with the fragrance of the finest perfume is not an exaggerated description of Carolina Jessamine vine when it is grown under cultivation. An evergreen vine, one of the most attractive in the State. Although the plants usually produce only a few flowers in the woods, they bloom profusely when brought into cultivation. Found in woods and swamps in parts of areas 2, 3, 5, 6, 8, 9, 10, and perhaps other localities in the State. See map, page 8. Adapted to sunny or shady situations. Somewhat difficult to transplant. Moving is usually more successful when small plants are taken up with a ball of earth around the roots and the entire top removed at the surface of the soil. Hardy throughout the State. Useful for arbors, pergolas, trellises and fences. It will not climb on wood or masonry wall without supports.

Form: twining vine. **Leaves** opposite, dark green, 1 to 2½ inches long, margins smooth. **Flowers** bright yellow, fragrant, trumpet-shaped, 1¼ to 1½ inches long. **Twigs** slender, flowering shoots reddish brown; pith white, chambered at the nodes and finally excavated between them.

OAKLEAF HYDRANGEA, *Wild Hydrangea**Hydrangea quercifolia*

A nursery catalogue from the north has this to say about Oakleaf Hydrangea: "A rather new and rare shrub that is a joy to behold. In June it has superb panicles of white flowers, often a foot long. The foliage resembles oak leaves and is attractive all season. It will certainly be the center of attraction in your yard. Price \$.75 each." A coarse textured deciduous shrub which grows to a height of 3 to 6 feet, producing large attractive white blooms. It is found along river banks, bluffs, and woods in sunny or shady places. Well-drained, acid, cool, moist soil with abundant organic matter is necessary in growing vigorous plants. Fairly easy to transplant when small. Occurs in areas 1, 3, 5, and 6. See map, page 8. May be used in borders, groups, foundation plantings, parks, and roadside masses.

Form: ascending stems, sparingly branched. **Leaves** opposite, 4 to 8 inches long, lobed, margins toothed, smooth above, dense white hairs beneath, long petioled. **Flowers** white becoming purple with age, borne in panicles 4 to 7 inches long on the ends of branches during May and June. The dried flowers often remain on plants during winter. **Twigs** stout, covered with small red hairs; older bark flakes off.



Figure 23—Possumhaw

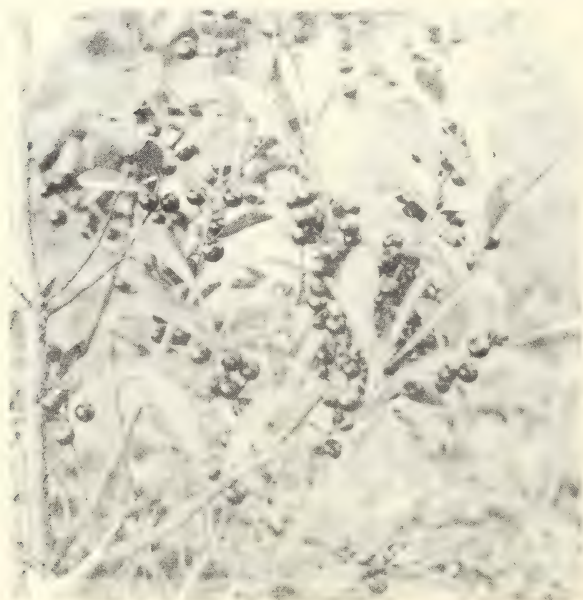


Figure 24—Inkberry

POSSUMHAW, *Deciduous Holly**Ilex decidua*

One of the most striking species of holly during winter after shedding its foliage in fall, leaving the twigs covered with a profusion of red fruits during winter. Sometimes attains a height of 30 feet. It may be used in landscape plantings in all sections of the State. It is found growing native on bottom and fertile upland soil more frequently in sunny situations, although it will tolerate shade. Widely distributed in the State in areas 1, 2, 4, 5, 6, 7, and perhaps others. See map, page 8. Similar to other species of holly in that it is somewhat difficult to transplant if not moved with a ball of earth around the roots. Useful for borders, groups, hedges, and roadside masses. The fruits are eaten by several species of birds.

Form: fairly compact, spreading branches from upright stems. **Leaves** alternate, $1\frac{1}{2}$ to 3 inches long, margins rounded toothed, rather thin, dark green above, pale beneath. **Flowers** small, greenish-white, inconspicuous. **Fruits** orange or orange-scarlet, $\frac{1}{4}$ - to $\frac{1}{3}$ -inch in diameter, remains throughout winter. Produced on female plants only, and pollen from male plants must fertilize the female flowers for the production of fruit. **Twigs** slender, light gray.

INKBERRY, *Gallberry**Ilex glabra*

A handsome broadleaf evergreen shrub which grows to 8 feet in height. Attractive for its foliage and black fruits that remain throughout winter. The fruits are a source of food for birds, and flowers are important in the production of honey. Plants usually found in clumps which gradually grow larger as a result of frequent forest fires which kill the tops causing many sprouts to arise from the roots. Grows on sandy hill land or fertile bottoms in full sun or shaded situations. Hardy throughout the State, but is native only in the longleaf pine and Gulf coastal plain areas of south Mississippi, areas 9 and 10. See map, page 8. Very difficult to transplant from burned-over land because of the extensive, poorly branched, root system. Nursery grown, well-shaped plants with a ball of earth are more desirable for landscape plantings. Used for foundation plantings, borders, groups, roadside mass plantings, hedges, and screens. A plant which should be widely used in the South. More extensively grown by northern gardeners and considered more valuable in landscape plantings in Northern states.

Form: much branched from upright stems. **Leaves** alternate, 1 to 2 inches long, thickish, smooth margin or sparingly toothed above the middle; waxy dark green above, paler green beneath.



Figure 25—Swamp Gallberry



Figure 26—American Holly

Flowers small, white or greenish-white in April. **Fruit** black, $\frac{1}{4}$ - to $\frac{1}{3}$ -inch in diameter produced in clusters in fall and winter on female plants. Male plants are necessary for pollination. **Twigs** of older wood grayish green, rather slender, brittle, coarse grained.

SWAMP GALLBERRY

Ilex lucida

A broadleaf evergreen shrub which grows to a height of 3 to 10 feet. Attractive for its foliage and the glossy black fruits produced by female plants in fall and winter. Most frequently found in clumps growing in swamps and lowlands; however, plants are adapted to well-drained upland soil. Grows well in full sun or partially shaded situations. Distributed throughout the longleaf pine and Gulf coastal plain areas of south Mississippi. Rarely able to transplant if not nursery grown. Useful for screen plantings, groups, borders, and naturalizing.

Form: upright stems, fairly compact. **Leaves** alternate, thickish, dark green above, margins smooth or remotely toothed, $1\frac{1}{4}$ to 3 inches long, on thickish petioles $\frac{1}{4}$ - to $\frac{1}{3}$ -inch long. **Flowers** white, about $\frac{1}{4}$ -inch across, in April. **Fruit** black, shining, $\frac{1}{4}$ - to $\frac{1}{3}$ -inch in diameter during fall. **Twigs** smooth, rather slender, older branches grayish color.

AMERICAN HOLLY

Ilex opaca

This is perhaps the most popular species of holly and the one most sought after for decorations at Christmas. This small evergreen tree often attains a height of 45 feet, and is suitable for sunny or partially shaded places throughout the State. Commonly found in acid soils in woods, swamps, and on stream banks in areas 1, 3, 5, 6, 8, 9, and 10. See map, page 8. It may be used in landscape plantings for shade, specimens, screens, borders, background, and roadsides. People should be more cautious in cutting branches and destroying trees on land without permission of the owner and more particularly along highways. Rather difficult to transplant. Plants should be moved only with a ball of earth around the roots. Nursery grown female plants are preferable.

Form: usually cone-shaped with spreading branches from a central leader. **Leaves** alternate, rather thick, leathery, smooth, dark green above, yellowish green below, $1\frac{1}{2}$ to 4 inches long, spines along the margins; usually the leaves persist throughout winter and shed in early spring. **Flowers** on female plants are small, white, inconspicuous, and must be pollinated from male trees for the production of fruit. **Fruit** red, conspicuous, $\frac{1}{4}$ - to $\frac{1}{3}$ -inch in diameter, borne on female trees, and usually persists throughout the winter unless subjected to severe cold. **Twigs** rather slender, light gray, smooth bark; pith small, continuous.

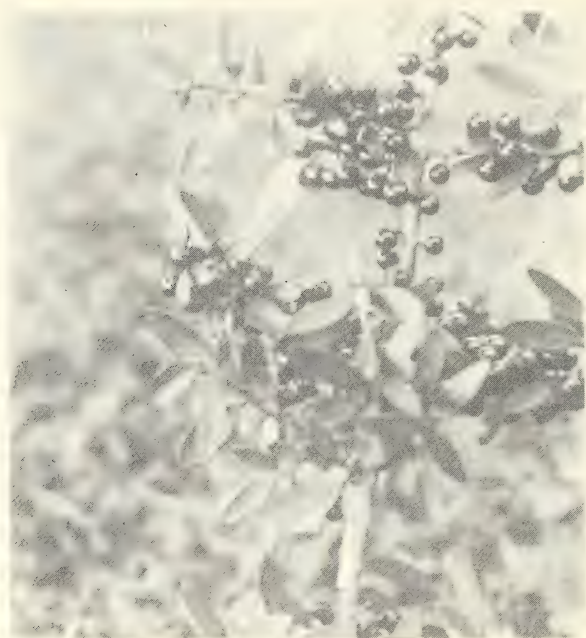


Figure 27—Yaupon



Figure 28—Florida Anisetree

YAUPON

Ilex vomitoria

Yaupon is rapidly coming into its own place of importance in Mississippi landscape work as more people discover its beauty, hardiness, multiplicity of uses, and freedom from insect and disease troubles. Its rich evergreen foliage and glossy brilliant red berries that persist all winter make it one of the most popular native evergreen shrubs. It often grows to a height of 25 feet. Valuable for its fine-textured, attractive foliage, and the profusion of glossy scarlet fruits produced on female plants which remain throughout the fall and winter. Fruits eaten by several species of birds. Found in sunny or shady situations, on hill or bottom land, often in edge of woods around old fields. Hardy throughout State, native in the longleaf pine and Gulf coastal plain areas of south Mississippi. Transplant with ball of earth unless plants are very small. Nursery-grown plants are more easily transplanted. Valuable as an ornamental shrub for use in borders, hedges, screens, roadside groups, foundation plantings, and wild gardens. Should be used more extensively in landscape plantings.

Form: spreading branches, usually compact when growing in open. **Leaves** alternate, $\frac{1}{2}$ - to 1-inch long, $\frac{1}{4}$ - to $\frac{1}{2}$ -inch broad, glossy, dark green or grayish green above, paler beneath, margins rounded toothed. **Flowers** small, inconspicuous. Male and female flowers produced on separate plants. **Fruits** glossy, scarlet, $\frac{1}{8}$ - to $\frac{3}{16}$ -inch in diameter, borne profusely on branches of the previous year's growth. Although female plants produce fruits, male plants must be present to pollinate the flowers of female plants. **Twigs** rather slender, gray, smooth, brittle, often developing into spurs.

FLORIDA ANISETREE, *Stinkbush*, *Flintleaf**Illicium floridanum*

One of the most attractive broadleaf evergreen shrubs native to south Mississippi. It grows to a height of 6 to 10 feet in swamps, banks of streams and low hammocks in dense shade or full sun where the soil is well-drained. Although it is hardy throughout the State, it is found native only in the longleaf pine belt of south Mississippi as a companion plant with Mountain-laurel and other acid-loving plants. It may be used in borders, foundation plantings, groups, parks, wild gardens, and roadsides. Reputed to be poisonous to livestock. A plant which should be more widely used in landscape plantings.

Form: upright stems, fairly compact. **Leaves** alternate, apparently whorled, dark green, thick, smooth, rosin scented, $2\frac{1}{2}$ to 6 inches long, smooth edges, often confused with Mountain-laurel. **Flowers** dark red, 1 to $1\frac{1}{2}$ inches across, solitary, produced in April. When bruised blooms have odor of decaying fish. **Twigs** rather stout; grayish and somewhat angled when young.



Figure 29—Virginia Sweetspire



Figure 30—Eastern Redcedar



Figure 31—Mountainlaurel Kalmia

VIRGINIA SWEETSPIRE, *Virginia-willow*, *Tassel-white*
Itea virginica

A rather slow-growing deciduous shrub which grows to a height of 2 to 6 feet. Usually found in low wet places and banks of streams in acid soil. Found in sun or shade, wet or well-drained soil in areas 1, 5, 9, and 10. See map, page 8. Hardy throughout State. May be used in borders, groups, foundation plantings, parks, and roadsides.

Form: rather erect, somewhat loosely branched. **Leaves** alternate, 1 to 3 inches long, bristly toothed edges, green above, pale beneath, turn red in fall of year. **Flowers** fragrant, white, in dense terminal racemes 2 to 6 inches long in late April and May. **Raceme** of **capsules** bearing the seed often remain on plants during winter. **Twigs** slender, usually smooth.

EASTERN REDCEDAR, *Cedar*
Juniperus virginiana

The well-known Redcedar, which is a narrowleaf evergreen, often grows to be a large tree; it may be sheared to produce a shrubby plant. Found throughout the hill section of the State in woods and dry hillsides, usually in full sun. A variety of forms occur making it desirable for many uses in the landscape. It lends itself well to shearing into various shapes. Useful for borders, background plantings, specimens, screens, hedges, accent plantings, and roadsides.

Form: spreading, usually cone-shaped. **Leaves** scale-like, evergreen, strongly scented. **Branches** strong, somewhat slender; bark, dark brown, loose, rather thin; heartwood, reddish brown.

MOUNTAINLAUREL KALMIA, *Poison Ivy*, *Calico Bush*
Kalmia latifolia

Some indication as to the popularity of Mountainlaurel is given in the fact that it has been proposed as our national flower. A slow-growing evergreen with handsome flowers and attractive foliage, usually growing to a height of 6 to 10 feet, but occasionally becoming a small tree as much as 35 feet high. Found on hillsides, in swamps, and along stream banks in acid soils in parts of areas 1, 5, lower 6, 9, and 10. See map, page 8. Although it is best suited to shady or partially shady situations, it will grow in sunny places if there is sufficient soil moisture. Light sandy, peaty, acid soils with a mulch of pine straw, peat or leaf mold is preferable for this shallow fibrous rooted plant. Although there is considerable interest in this plant, it is seldom seen in cultivation

in Mississippi and rarely offered for sale by nurseries in the lower South. When possible, it is best to use nursery-grown plants for landscape plantings, but small plants moved with a ball of earth and naturally layered branches can be moved from the woods if one is especially careful to use good transplanting methods and judicious care until the plants are well established. It should be widely used in borders, foundation plantings, parks, roadsides, and wild gardens. It is often called Poison Ivy because it is claimed that it kills cows when eaten in January, June, or October; however, it does not cause skin irritation on humans.

Form: spreading, usually compact. **Leaves** alternate, opposite or whorled, thickish, dark green above, yellowish green below, 2 to 5 inches long, smooth edges. **Flowers** borne in clusters, light pink to white with purple markings, produced in April. Individual flowers fluted in bud stage, cup-shaped when open, about $\frac{3}{4}$ -inch across. **Twigs** rather stout, brittle, often fuzzy when young.



Figure 32—Coast Leucothoe



Figure 33—Sweetbells Leucothoe

COAST LEUCOTHOE

Leucothoe axillaris

The fragrant waxy flowers of the Coast Leucothoe reminds one somewhat of Lily-of-the-Valley. A useful evergreen shrub which grows to a height of 3 to 5 feet. Occurs in areas 9, and 10 along stream banks, in damp woods, and swampy thickets. See map, page 8. It thrives best on sandy acid soil containing organic matter. Shady or partially shady situations are preferable for best growth, but it will grow in full sun if the soil remains moist throughout the year. A mulch of pine straw, leafmold or peat around the plants is desirable to maintain uniform moisture content of the soil. Easily transplanted with a ball of earth if a good root system is present. Useful in low shady borders, foundation plantings, groups, wild gardens, and parks. Hardy throughout the State.

Form: usually in dense clumps of ascending, arching branches. **Leaves** alternate, 2 to 4 inches long, glossy dark green above, pale green beneath, edges slightly toothed. **Flowers** white, somewhat bell-shaped, nodding, $\frac{1}{4}$ - to $\frac{3}{8}$ -inch long, borne in short racemes 1 to 2 inches long in the axils of leaves during April and May. **Fruit** somewhat pumpkin-shaped about $\frac{3}{8}$ -inch across. **Twigs** rather slender, roundish, green when young; pith often 3-sided.

SWEETBELLS LEUCOTHOE, *Fetterbush**Leucothoe racemosa*

A deciduous shrub which grows to a height of 6 to 10 feet. Found in acid swamps and bogs, or well-drained soil exposed to full sun or more often in shady situations. Occurs in the long-leaf pine belt of south Mississippi and possibly other areas in the State. Hardy throughout Mississippi; it should be grown only on acid soil. Useful in borders, groups, foundation plantings, parks, wild gardens, and roadsides. Poisonous to livestock, especially calves.

Form: erect rather sparingly branched. **Leaves** alternate, 1 to 3 inches long, rather thin, edges toothed. **Flowers** white, $\frac{1}{3}$ -inch long, nodding, somewhat cylindrical in shape, produced in racemes 2 to 4 inches long in April. **Twigs** rather slender.

TRUMPET HONEYSUCKLE, *Woodbine, Coral Honeysuckle**Lonicera sempervirens*

This vine looks like a sheet of flame when in full bloom. It predominates the color scheme in the garden during its flowering period. Trumpet Honeysuckle makes its own excellent background for the flowers with the glossy green leaves it produces. An evergreen or half evergreen vine found in thickets, swamps, woods, and fence rows. Hardy throughout State, suitable for sunny or shady situations in fertile, well-drained soil. Found in



Figure 34—Trumpet Honeysuckle



Figure 35—Fetterbush Lyonia



Figure 36—Southern Crab

areas 1, 5, 6, and probably other localities in State. See map, page 8. A climber which is used on fences, trellises, and other structures.

Form: much branched vine. **Leaves** opposite, oval, 2 to 3 inches long, thickish, light green above, whitish beneath, edges smooth, terminal leaves often unite around the stem. **Flowers** trumpet-shaped, $1\frac{1}{2}$ to 2 inches long, outside scarlet or red, yellow throat, borne in clusters. **Twigs** twining, rounded, slender.

FETTERBUSH LYONIA

Lyonia lucida

An attractive slow-growing broadleaf evergreen which grows to a height of 3 to 6 feet. Found in moist pinelands, swamps, and along the banks of streams and pools in areas 9, and 10. See map, page 8. It prefers shady situations, but it will grow in full sun where there is sufficient moisture. Acid, light sandy, or peaty soils are preferable. In the woods the ascending stems are sparingly branched, but when brought into cultivation with proper care it grows into a much more attractive plant. Hardy throughout the State. Easily transplanted with a ball of earth and a good root system. Useful in foundation plantings, borders, groups, and wild gardens.

Form: upright to arching branches, sparingly branched. **Leaves** alternate, 1 to 3 inches long, glossy, dark green, thick, leathery, prominent midvein, and smooth margin. **Flowers** white or pinkish, nodding, somewhat bell-shaped, $\frac{1}{4}$ - to $\frac{1}{3}$ -inch long, borne in clusters in the axils of the leaves in April and May. **Fruit** brown or brownish-black, about $\frac{3}{16}$ -inch long, usually remain on the plant during winter after the seeds have fallen out of the capsule. **Twigs** slender, prominently angled, new growth reddish, later turning green.

SOUTHERN CRAB

Malus angustifolia

Just as the leaves begin to unfold the exquisite blooms of the crab begin to open, filling the air with their delightful fragrance. A deciduous shrub or small tree which sometimes attains a height of 25 to 30 feet. Found in thickets and edge of woods usually in full sun. Grows in dry or moist well-drained soils in areas 1, 4, 5, 6, 9, and probably others. See map, page 8. Useful for borders, groups, specimens, and roadsides. It is relatively easy to transplant.

Form: upright trunk with rigid spreading branches. **Leaves** alternate, 1 to 2 inches long, thickish, dark green above, edges toothed. **Flowers** pink, about 1-inch across, borne in 3 to 5 flowered clusters at the ends of fruit spurs during April. **Fruit** greenish-yellow, 1 to $1\frac{1}{3}$ inches in diameter. **Twigs** stout, light brown with rather sharp fruit spurs.



Figure 37—Southern Waxmyrtle



Figure 38—Devilwood Osmanthus

SOUTHERN WAXMYRTLE, *Waxberry, Candleberry**Myrica cerifera*

A vigorous growing deciduous or semi-evergreen shrub which usually grows 10 to 20 feet high, but sometimes attains a height of 40 feet. Usually found in hammocks and swamps in sunny or shady situations. It is adapted to well-drained or poorly-drained soil. Although it is hardy throughout the State, it is native in the lower part of areas 5 and 6, all of areas 9 and 10. See map, page 8. May be used in borders, groups, screens, hedges, and roadside plantings. Adapted to a wide range of soil conditions. Small plants are easily transplanted with a ball of earth around the roots. *Myrica caroliniensis* which is very similar to the species described is lower growing and is more commonly cultivated. Wax from fruit was formerly used in making bayberry candles—hence the common name.

Form: spreading, usually compact. **Leaves** alternate, 1 to 3 inches long, usually coarsely toothed above the middle, abruptly pointed at apex, wedge-shaped at base, dark green or yellowish-green, paler beneath. **Fruits** grayish, borne in clusters along the stems, remain on plants throughout winter. **Flowers** inconspicuous. **Twigs** slender, resinous dotted when young, spicy odor; pith small, somewhat angled, continuous, green.

DEVILWOOD OSMANTHUS, *Wild Olive**Osmanthus americana*

A rather coarse-textured evergreen shrub or small tree, occasionally attaining a height of 40 feet, but more often growing to a height of 15 to 20 feet. Found in swamps and lowlands in sunny or shady situations, in lower part of area 6 and in areas 9 and 10. See map, page 8. Hardy throughout the State. Suitable for use in borders, groups, backgrounds, screens, and roadside plantings.

Form: rather upright, somewhat loosely branched. **Leaves** opposite, short petioled, $2\frac{1}{2}$ to 7 inches long, glossy green above, pale beneath, smooth margins. **Flowers** small, white, fragrant, in clusters terminating branches during March and April. **Twigs** rather slender, whitish bark, dark brown heart-wood.

VIRGINIACREEPER

Parthenocissus quinquefolia

A deciduous vine attractive for the brilliant red autumn color of its handsome foliage and dark blue clusters of fruits. Found throughout the State in woods, thickets, hills, and bottom land, in



Figure 39—Virginiacreeper



Figure 40—Flamcleaf Sumac



Figure 41—Smooth Sumac

sunny or shady situations. Used on wood or masonry structures and occasionally used on trunks of trees. It is easily transplanted bare-rooted.

Form: a vine which climbs by means of tendrils with adhesive tips. **Leaves** alternate, palmate with five leaflets, coarsely toothed above the middle, dull green above, decidedly paler beneath, petiole longer than leaflets. **Fruit** deep blue, $\frac{1}{4}$ - to $\frac{1}{3}$ -inch in diameter, produced in clusters, fall and winter. **Twig** rather slender; pith relatively large, greenish, continuous.

FLAMELEAF SUMAC, *Shining Sumac*

Rhus copallina

A deciduous shrub which is grown for its brilliantly colored foliage in the fall, sometimes attaining a height of 30 feet but it is usually much smaller. Found throughout the State usually on dry, often stony, hillsides. Although it will tolerate considerable shade, it thrives best in full sun. Useful in borders, groups, parks, and roadside masses. Particularly useful in poor, dry soil. It is easily transplanted. In most situations drastic pruning each year is desirable since this dwarfs the plants considerably and makes the plants produce more branches.

Form: upright stems sparingly branched. **Leaves** compound, alternate, winged rachis, 9 to 21 leaflets, usually smooth edges, smooth and shining above, unequal at base. **Flowers** in large terminal clusters, yellowish-green color. **Fruits** in drooping panicles during fall. **Twigs** round or bluntly 3-sided, stout, coarse-grained, light, soft, sap milky; heartwood brown streaked with green.

SMOOTH SUMAC, *Scarlet Sumac, Shoemake*

Rhus glabra

The sumacs give much brilliant color to the fall landscape, when red and orange leaves are topped by clusters of red fruit that persist for several months. A deciduous shrub usually growing to a height of 6 to 8 feet, occasionally to 15 feet. Distributed throughout the State, usually found in dry, rich soil in open woods and edges of thickets. Plants usually occur in small or large groups; best suited to full sun exposure. The sumacs should be more widely used in landscape plantings since they are well adapted to borders, groups, and mass plantings along the highway. Grows well on dry banks if soil is fertile. Seeds eaten by many birds.

Form: upright, sparingly branched. **Leaves** alternate, compound with 11 to 31 blades, $1\frac{1}{2}$ to 3 inches long, margins toothed, dull green above, whitish beneath, bright red in fall. **Fruit** large, crimson, velvety terminal clusters in fall. **Twigs** stout, milky sap; heartwood orange colored streaked with green, coarse grained, soft, brittle.



Figure 42—Staghorn Sumac



Figure 43—Pinksterbloom Azalea

STAGHORN SUMAC, *Hairy Sumac**Rhus typhina*

This well-known deciduous shrub that occasionally grows to a height of 30 feet is grown for its fall color of foliage and attractive fruits that remain throughout winter. Found throughout the State, usually in large groups along roadsides, in thickets, and open woods. Grows in a wide variety of well-drained soils and is particularly well suited to those which are dry and gravelly. Although it will tolerate shade, full sun is preferable. Useful in borders, parks, and roadside masses. It is easily transplanted. Drastic pruning each year is often desirable.

Form: upright stems sparingly branched. **Leaves** alternate, compound, covered with small hairs; leaflets 11 to 31, 1½ to 6 inches long, edges toothed, pale beneath. **Fruits** dark red, hairy, in large terminal clusters that remain throughout winter. See figure 42. **Twigs** stout, covered with dense velvety hairs; wood coarse-grained, orange colored.

PINKSTERBLOOM AZALEA, *Honeysuckle, Wild Azalea**Rhododendron nudiflorum*

The exquisite blooms of this deciduous shrub are too often broken off the plant by Sunday afternoon motorists only to find the blooms, which could be enjoyed by others, wilted before they can be placed in water. This azalea, which usually grows to a height of 3 to 10 feet, is found in open woods, swamps, upland and lowland acid soils. It prefers shady situations but it will grow in full sun if the plants have sufficient moisture. Found rather commonly in most areas throughout the State, but seldom found in areas 2, 6, and 7. See map, page 8. The roots are fibrous and shallow, making it relatively easy to transplant when small. It grows best in acid soil with a mulch of pine straw, peat, or leaf mold. Valuable in landscape plantings when used in borders, groups, foundation plantings, wild gardens, parks, and roadsides.

Form: rather loosely branched, upright stems with spreading branches. **Leaves** unfold during blooming time, alternate, 2 to 4 inches long, older leaves rather thick and firm, margins smooth. **Flowers** light to dark pink, trumpet-shaped; borne in thick clusters at the ends of branches, sticky material covers the blooms; time of bloom March and April. **Twigs** slender, light brown; pith small, roundish, somewhat colored.



Figure 44—Carolina Rose



Figure 45—American Elder



Foliage



Flower

Figure 46—Common Sassafras

CAROLINA ROSE, *Wild Rose Pasture Rose**Rosa carolina*

Although native roses will probably never take the place of the cultivated hybrid roses, they have a definite place in landscape plantings because of their sturdy vigorous growth and beauty. A deciduous plant which grows to a height of 1 to 3 feet. Found in well-drained soil, and in sunny or partially shady situations. Although this species of rose has been found only in various parts of area 4, it probably occurs in other areas of the State. Useful in borders, groups, and roadsides. Easily transplanted.

Form: spreading, somewhat loosely branched. **Leaves** alternate, compound, usually 5, rarely 7; leaflets usually $\frac{1}{2}$ to $1\frac{1}{2}$ inches long, dull green above, usually somewhat paler beneath; edges with regular, sharp, ascending teeth. **Flowers** pink, usually solitary during May; petals 5, $\frac{3}{4}$ - to 1-inch long, usually reflexed. Stems slender, smooth; prickles paired, slender, straight.

AMERICAN ELDER, *Elderberry, Common Elder**Sambucus canadensis*

A common, fast-growing, deciduous shrub that grows to a height of 5 to 8 feet, sometimes larger. Known to most small boys who use the stems of these plants to make popguns. Found in open places, woods, stream banks and swamps, in sunny or shady situations throughout the State. Useful in borders, groups, and mass plantings along roadsides. Easily transplanted from the woods. By pruning the tops of the plants back to the ground level annually or biennially, thick growth and more dwarfed plants are produced.

Form: upright stems, sparingly branched. **Leaves** opposite, compound, with 5 to 11 leaflets, margins toothed, light green color. **Flowers** white, produced in clusters 6 to 12 inches across on the ends of branches during May and June. **Fruits** in large clusters following blooming and turning purplish black in late summer and fall; eaten by many birds. **Twigs** coarse, smooth, scarcely woody, large white pith.

COMMON SASSAFRAS

Sassafras albidum

A deciduous shrub or small tree which sometimes grows to a height of 30 to 60 feet. Grown for its handsome foliage with beautiful tints in fall and for its bright colored fruits. It is found commonly throughout the State on upland soil in woods, fields, and roadsides. It grows best in sun or partial shade. Difficult to eradicate when plants become established. Its use is questionable on the home grounds, but it may be used effectively in mass plantings along highways.



Figure 47—Laurel Greenbrier



Figure 48—Virginia Stewartia

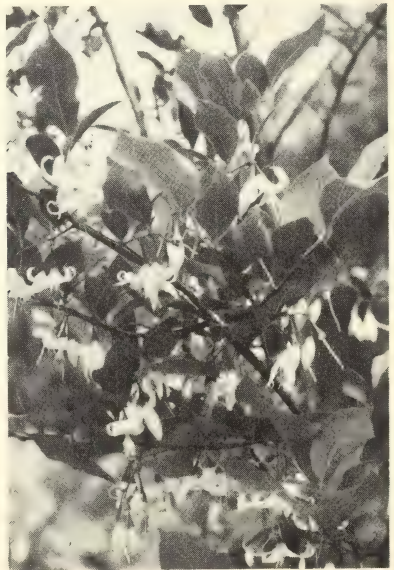


Figure 49—American Snowbell

Form: upright, rather sparingly branched. **Leaves** alternate, variously shaped, edges smooth, lobed or entire; yellow, orange, or red in fall. **Flowers** greenish-yellow, fragrant, about $\frac{1}{4}$ -inch across. **Fruits** oval, dark blue, $\frac{1}{4}$ - to $\frac{1}{3}$ -inch long. **Twigs** yellowish-green, smooth, roundish, brittle; pith white, somewhat 5-sided, continuous.

LAUREL GREENBRIAR, *Smilax Vine*, *Bamboo Vine*
Smilax laurifolia

The smilax vine, as it is usually called, is probably more often used in decoration of various kinds such as weddings, banquet rooms, and convention halls, than in landscape plantings. This vigorous, fast-growing evergreen vine is one of the most desirable vines found in the State because of its attractive evergreen foliage and berries in autumn. Found usually in swamps, hammocks, and wet places, where it makes a dense tangle of vines that are difficult to penetrate. Grows well in sunny or shady places. Found in area 9 and probably other localities of the State. See map, page 8. Hardy throughout the State. Easily transplanted. Used on trellises, arbors, and other structures where it may climb by tendrils. Other kinds of smilax may be substituted in plantings when Laurel Greenbriar is unobtainable.

Form: rather thick-growing vine. **Leaves** alternate 2 to 6 inches long, dark green, somewhat leathery, smooth edges, 3 or 5 prominent veins. **Flowers** small, greenish white in clusters during July and August. **Fruits** black, about $\frac{1}{4}$ -inch in diameter which ripen in September of the second year after blooming. **Stems** stout, armed with thorns. **Roots** with large fleshy tubers, suggesting large potatoes.

VIRGINIA STEWARTIA, *Silky Camellia*
Stewartia malachodendron

An attractive, little-known deciduous shrub which grows to a height of 6 to 12 feet. It thrives best in deep, rich, moderately moist porous soils, in sunny or shady places. Usually found in swamps and bottom land in areas 9, 10, and lower part of area 6. See map, page 8. Valuable for borders, groups, foundation plantings, parks, wild gardens, and roadsides. Hardy throughout the State.

Form: rather upright stems with spreading branches. **Leaves** alternate, $2\frac{1}{2}$ to 4 inches long, oval, light green, fine hairs beneath, margins toothed. **Flowers** white, somewhat similar to a single camellia, 3 to 4 inches across, 5 petals, borne singly in the axils of leaves during April and May. **Twigs** moderately slender, bark shredding; pith rounded and somewhat spongy.



Figure 50—Indiancurrant Coralberry



Figure 51—Witherod Viburnum

AMERICAN SNOWBELL, *Storax**Styrax americana*

A deciduous shrub which grows to a height of 7 to 8 feet. It is usually found in swamps and along stream banks in light, porous soil. Grows in either sun or shade. Hardy throughout the State. It has been found in areas 5, 9, and 10. See map, page 8. Useful in borders, groups, and roadsides.

Form: rather spreading, somewhat loosely branched. **Leaves** alternate, bright green, 1 to 3 inches long, margins usually not toothed. **Flower** petals white, stamens yellow, fragrant, nodding, borne in few flowered clusters in April and May. Flower petals reflexed, about $\frac{1}{2}$ -inch long. **Twigs** rather slender, rounded, zig-zagged; pith small, rounded, continuous, green.

INDIANCURRENT CORALBERRY

Symphoricarpos orbiculatus

A deciduous shrub with showy purplish-red fruit in winter which grows to a height of 2 to 5 feet. Found in thickets, edge of woods, on banks, and roadsides, in sunny or shady places. Occurs in areas 1, 2, and probably others. See map, page 8. Plants have shallow, fibrous root system making them easy to transplant bare-rooted from nursery or woods. Used in borders, groups, foundation plantings, banks, and roadsides. An excellent plant for the bird garden.

Form: ascending, arching branches, rather compact. **Leaves** opposite, $\frac{3}{4}$ to $1\frac{1}{2}$ inches long, oval, smooth margins, usually fine hairs beneath. **Flowers** greenish-red, about $\frac{1}{6}$ -inch long, borne in clusters in axils of leaves. **Fruit** purplish-red, $\frac{1}{8}$ - to $\frac{1}{4}$ -inch across produced in compact clusters in the axils of leaves during fall and early winter. **Twigs** roundish, slender; pith small, rounded, somewhat brownish.

WITHEROD VIBURNUM, *Swamp Haw*, *Wild Raisin**Viburnum cassinoides*

A plant which has been widely used in landscape plantings in the North, where it is grown for its attractive flowers and fruits; however, it has been seldom used in the lower South. A deciduous shrub which grows to a height of 8 to 12 feet, usually found in swamps and wet woods. It grows well in either sun or shade, wet or well-drained soil. Although it is hardy throughout the State, it has been found growing native by the author only in areas 9, and 10. See map, page 8. Useful in landscape plantings in borders, groups, foundation plantings, parks, roadsides, and wild gardens.



Figure 52—Nannyberry Viburnum



Figure 53—Possumhaw Viburnum

Form: upright stems, rather sparingly branched. **Leaves** opposite, thickish, dull green, 2 to 4 inches long, margins smooth or sparingly toothed. **Flowers** white with yellow stamens borne in clusters 3 to 5 inches across, during April and May. **Fruit** in clusters, pinkish in summer, turning to dark blue in fall and winter. Eaten by several species of birds. **Twigs** moderately slender, more or less 6-sided. **Buds** brown, scurfy.

NANNYBERRY VIBURNUM, *Wild Raisin, Sweet Viburnum*
Viburnum lentago

A deciduous shrub which is attractive for its fine display of flowers in spring, and attractive glossy foliage. Sometimes it grows to a height of 30 feet, but usually it is smaller. It is found in woods and on banks of streams in well-drained, moist, rich loam. Hardy throughout the State, and suitable for sunny or shady situations. Occurs in areas 1, 2, 5, and probably other parts of the State. See map, page 8. Useful in borders, groups, parks, and roadside mass plantings. Easily transplanted from nursery or woods.

Form: spreading, somewhat loosely branched. **Leaves** opposite, 1½ to 4 inches long, glossy above, margins finely and sharply toothed. **Flowers** white in terminal clusters, 2 to 5 inches across, in April. **Fruit** oval, 1/3- to ½- inch long, borne in clusters, bluish-black during fall and winter.

POSSUMHAW VIBURNUM, *Swamp Haw*
Viburnum nudum

A deciduous shrub which grows to a height of 10 to 15 feet. Usually found in swamps and lowland where it thrives in sunny or shady places. It occurs in areas 5, 6, 9, and 10. See map, page 8. Suitable for plantings in well-drained or poorly-drained soils throughout the State. Used in borders, groups, parks, and roadside plantings. Small plants easily transplanted bare-rooted from nursery or woods.

Form: upright stems, sparingly branched. **Leaves** opposite, thickish, scurfy on both sides when young, rather glossy above 2 to 6 inches long, margins undulate or obscurely toothed. **Flowers** white or yellowish-white, borne in clusters 3 to 5 inches across, in April and May. **Fruit** ¼- to 1/3-inch long, deep blue, become shriveled but hang on plants until late winter; edible. **Twigs** moderately slender, more or less 6-sided.

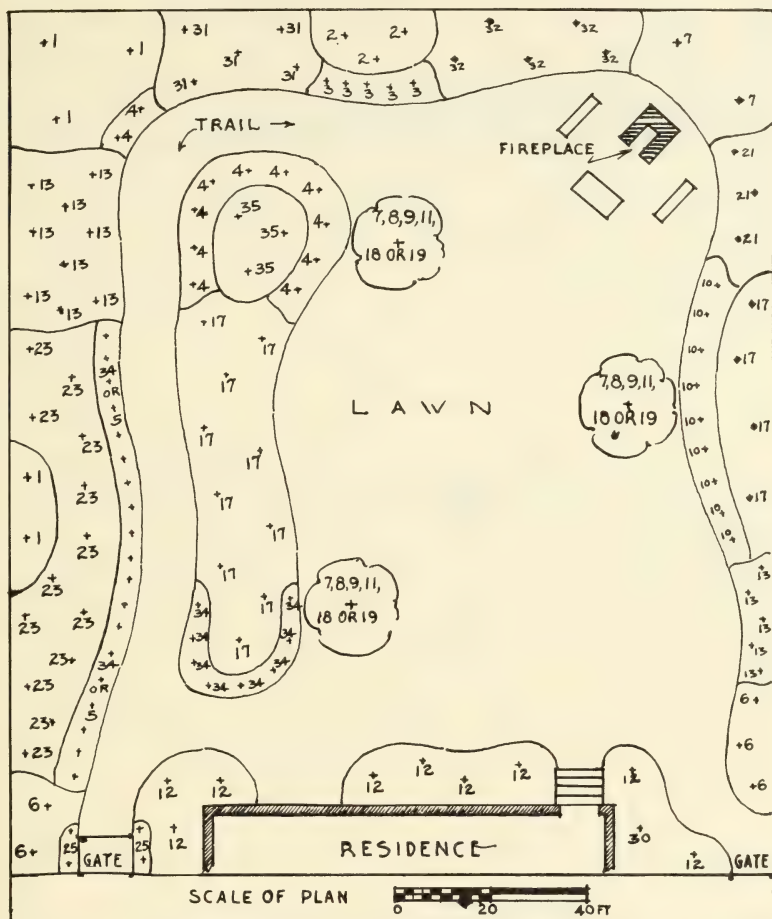


Figure 57—Most native shrubs are well adapted to border plantings or wild gardens. The plan above outlines suggestions for locations and combinations of native plants for the "backyard garden".

Native Plants Found Rather Generally Over State to be Used
Throughout the State Where Soil Conditions are Favorable

- | | | |
|-------------------------|---------------------------|---------------------------------|
| 1. Hazel Alder | 11. American Holly | 21. Red Buckeye |
| 2. Indigobush Amorpha | 12. Mountainlaurel Kalmia | 22. Virginia Sweetspire |
| 3. Red Chokeberry | 13. Pinksterbloom Azalea | 23. Huckleberry |
| 4. American Beautyberry | 14. Sumacs | 24. Wild Rose |
| 5. Jersey Tea Ceanothus | 15. American Elder | 25. Carolina Jessamine |
| 6. Common Buttonbush | 16. Common Sassafras | 26. Laurel Greenbriar or Smilax |
| 7. Eastern Redbud | 17. Yaupon* | 27. Carolina Snailseed |
| 8. White Fringetree | 18. Hawthorn | 28. Trumpet Honeysuckle |
| 9. Flowering Dogwood | 19. Southern Crab | 29. Virginian creeper |
| 10. Brook Euonymus | 20. Eastern Redcedar | |

Native Plants Found Only
in South Mississippi. Hardy
Throughout State:

- | |
|--|
| 30. American Snowbell or Sweetbell Leucothoe |
| 31. Witherod Viburnum |
| 32. Florida Anisetree |
| 33. Southern Waxmyrtle |
| 34. Inkberry (Gallberry), Fetterbush Lyonia or Coast Leucothoe |
| 35. Possumhaw Viburnum, Devilwood Osmanthus |
| 36. Swamp Gallberry |
| 37. Buckwheatree |
| 38. American Cyrilla |
| 39. Virginia Stewartia |

Native Plants Found Only in
North Mississippi. May be
Used Throughout State:

- | |
|------------------------------|
| 30. Common Sweetshrub |
| 31. Roughleaf Dogwood |
| 32. Oakleaf Hydrangea |
| 33. Possumhaw |
| 34. Indiancurrant Coralberry |
| 35. Nannyberry Viburnum |

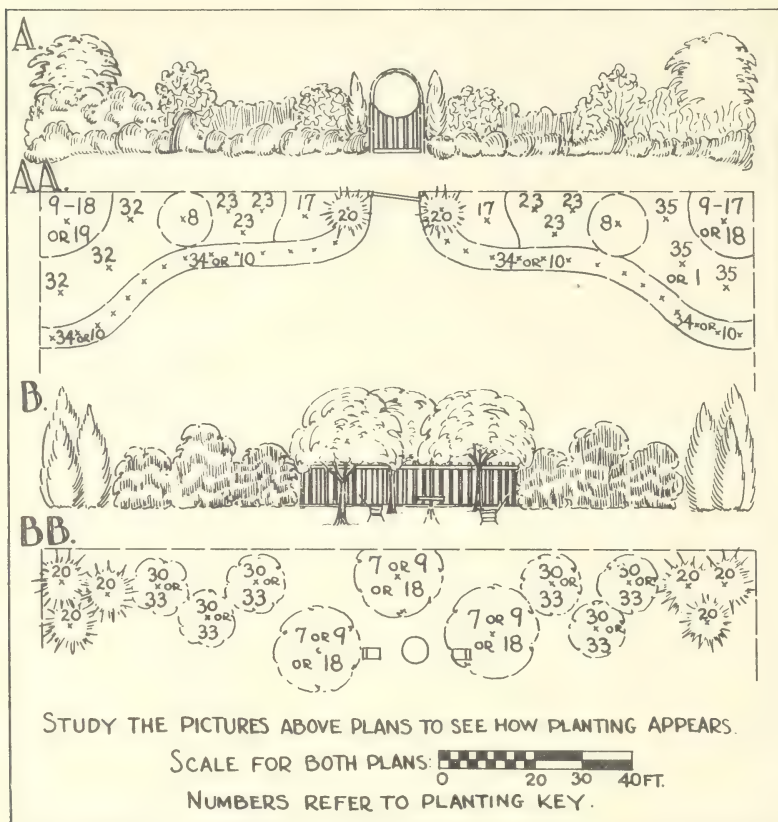


Figure 58—Native shrub planting for the border. A and B shows the picture; AA and BB shows plants used to make picture in A and B.

PLANT KEY

- | | | |
|---------------------------|--|---|
| 1. Hazel Alder | 19. Southern Crab | 34. Inkberry (Gall-
berry), Fetterbush
Lyonia or Coast
Leucothoe |
| 7. Eastern Redbud | 20. Eastern Redcedar | 35. Possumhaw |
| 8. White Fringetree | 23. Huckleberry | Viburnum, Devil-
wood Osmanthus |
| 9. Flowering Dog-
wood | 30. American Snowbell
or Sweetbell
Leucothoe | |
| 10. Brook Euonymus | 32. Florida Anisetree | |
| 17. Yaupon | 33. Southern Wax-
myrtle | |
| 18. Hawthorn | | |

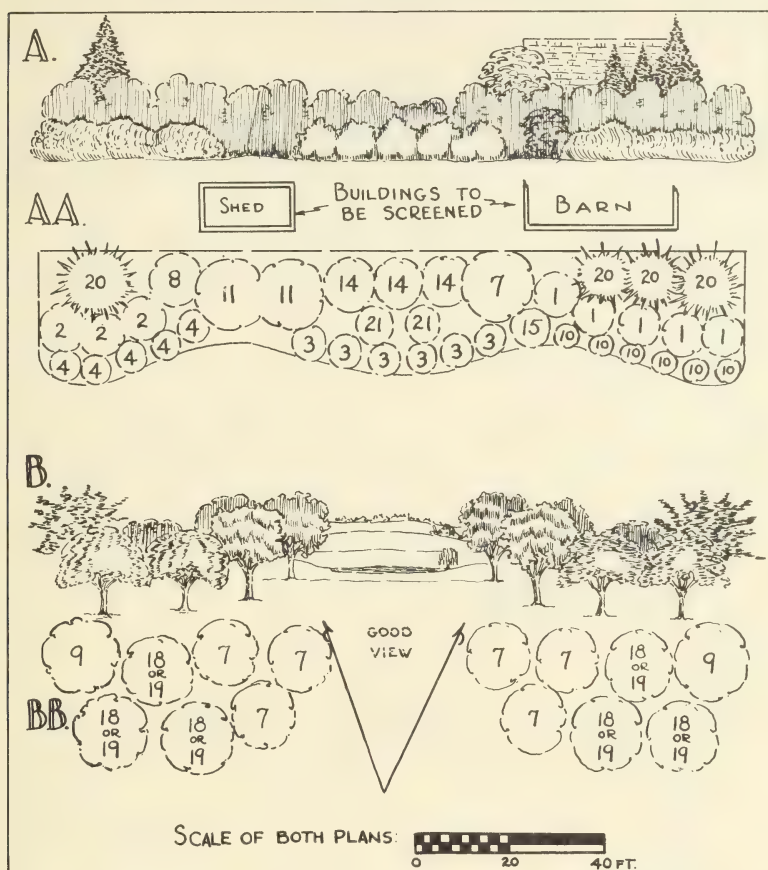


Figure 59—(A). Planting used as screen for unsightly building; (AA). plants used in making screen planting; (B). border of small trees leaving opening for a good view beyond; and (BB). location and kind of plants used.

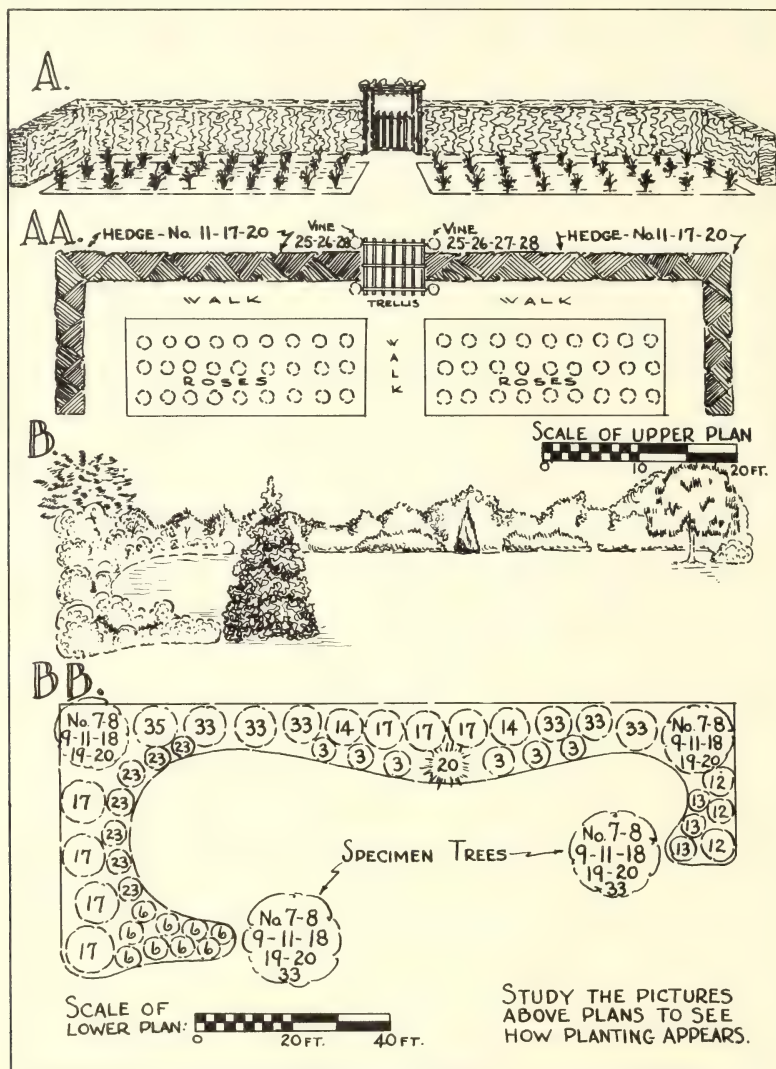


Figure 60—(A). Clipped hedge of native plants enclosing the rose garden; (AA). plants used for the enclosure; (B). informal border of native plants; and (BB). location and kind of plants used in picture B.

PLANT KEY

- | | | |
|-----------------------|------------------------|--|
| 3. Red Chokeberry | 13. Pinksterbloom | 26. Laurel Greenbriar or Smilax |
| 6. Common Button-bush | 14. Sumacs | 28. Trumpet Honey-suckle |
| 7. Eastern Redbud | 17. Yaupon | 33. Southern Wax-myrtle |
| 8. White Fringetree | 18. Hawthorn | 35. Possumhaw Viburnum or Devil-wood Osmanthus |
| 9. Flowering Dogwood | 20. Eastern Redcedar | |
| 11. American Holly | 23. Huckleberry | |
| 12. Mountainlaurel | 25. Carolina Jessamine | |

ULTIMATE HEIGHT OF PLANTS

Low

(2 to 5 feet)

Brook Euonymus
Coast Leucothoe

Fetterbush Lyonia
Indiancurrant Coral-
berry
Jersey Tea Ceanothus

Oakleaf Hydrangea
Virginia Sweetspire

Medium

(5 to 10 feet)

American Beautyberry
American Elder
American Snowbell
Common Buttonbush
Common Sweetshrub
Florida Anisetree

Huckleberry
Indigobush Amorpha
Inkberry
Mountainlaurel Kalmia
Pinksterbloom Azalea

Red Buckeye
Red Chokeberry
Swamp Gallberry
Sweetbells Leucothoe
Virginia Stewartia
Witherod Viburnum

Tall

(10 to 20 feet)

Buckwheattree
Devilwood Osmanthus
Hazel Alder

Nannyberry Viburnum
Possumhaw Viburnum
Roughleaf Dogwood

Southern Waxmyrtle
Sumacs
Yaupon

Small Trees

(Above 20 feet)

American Cyrilla
American Holly
Common Sassafras

Eastern Redcedar
Eastern Redbud
Flowering Dogwood
Hawthorn

Possumhaw
Southern Crab
White Fringetree

USES

Borders

American Beautyberry
American Cyrilla
American Elder
American Holly
American Snowbell
Brook Euonymus
Buckwheattree
Coast Leucothoe
Common Buttonbush
Devilwood Osmanthus
Eastern Redbud
Florida Anisetree

Flowering Dogwood
Hawthorn
Hazel Alder
Huckleberry
Indiancurrant Coral-
berry
Indigobush Amorpha
Inkberry
Jersey Tea Ceanothus
Mountainlaurel Kalmia
Nannyberry Viburnum
Pinksterbloom Azalea
Possumhaw

Possumhaw Viburnum
Red Buckeye
Red Chokeberry
Roughleaf Dogwood
Southern Crab
Southern Waxmyrtle
Sumacs
Swamp Gallberry
Sweetbells Leucothoe
Virginia Stewartia
Virginia Sweetspire
White Fringetree
Yaupon

Foundation Planting

American Snowbell
Brook Euonymus
Coast Leucothoe
Fetterbush Lyonia
Florida Anisetree
Huckleberry

Indiancurrant Coral-
berry
Inkberry
Jersey Tea Ceanothus
Mountainlaurel Kalmia
Oakleaf Hydrangea

Swamp Gallberry
Sweetbells Leucothoe
Virginia Stewartia
Virginia Sweetspire
Witherod Viburnum
Yaupon

Specimen

American Holly
Eastern Redbud
Eastern Redcedar

Flowering Dogwood
Hawthorn

Possumhaw
Southern Crab
White Fringetree

Clipped Hedge

American Holly
Brook Euonymus
Buckwheattree

Eastern Redcedar
Hawthorn
Inkberry
Possumhaw

Southern Waxmyrtle
Swamp Gallberry
Yaupon

TEXTURE OF FOLIAGE**Fine**

Eastern Redcedar
Fetterbush Lyonia

Huckleberry
Inkberry

Swamp Gallberry
Yaupon

Medium

American Holly
American Snowbell
Brook Euonymus
Buckweat tree
Coast Leucothoe
Common Sweetshrub
Hawthorn

Hazel Alder
Indian currant Coral-
berry
Indigobush Amorpha
Jersey Tea Ceanothus
Mountain laurel Kalmia
Nannyberry Viburnum

Pinksterbloom Azalea
Possumhaw
Red Chokeberry
Southern Crab
Southern Waxmyrtle
Sweetbells Leucothoe
Virginia Sweetspire

Coarse

American Beautyberry
American Cyrilla
American Elder
Common Buttonbush
Common Sassafras
Devilwood Osmanthus

Eastern Redbud
Florida Anisetree
Flowering Dogwood
Oakleaf Hydrangea
Possumhaw Viburnum

Red Buckeye
Roughleaf Dogwood
Sumacs
Virginia Stewartia
White Fringetree
Witherod Viburnum

EXPOSURE**Best Adapted to Sunny Places**

American Holly
Common Sassafras

Eastern Redbud
Roughleaf Dogwood

Sumacs
Yaupon

Best Adapted to Shady Places

Coast Leucothoe

Fetterbush Lyonia

Mountain laurel Kalmia

Suitable for Sunny or Shady Places

American Beautyberry
American Cyrilla
American Elder
American Snowbell
Brook Euonymus
Buckweat tree
Common Buttonbush
Common Sweetshrub
Devilwood Osmanthus
Florida Anisetree
Flowering Dogwood

Hawthorn
Hazel Alder
Huckleberry
Indian currant Coral-
berry
Indigobush Amorpha
Inkberry
Jersey Tea Ceanothus
Nannyberry Viburnum
Oakleaf Hydrangea
Pinksterbloom Azalea
Possumhaw

Possumhaw Viburnum
Red Buckeye
Red Chokeberry
Southern Crab
Southern Waxmyrtle
Swamp Gallberry
Sweetbells Leucothoe
Virginia Stewartia
Virginia Sweetspire
White Fringetree
Witherod Viburnum

PLANTS WHICH PRODUCE ATTRACTIVE FRUITS

American Beautyberry
American Elder
American Holly
Brook Euonymus
Carolina Snailseed
Flowering Dogwood
Hawthorn

Huckleberry
Indian currant Coral-
berry
Inkberry
Laurel Greenbriar
Possumhaw
Possumhaw Viburnum
Red Chokeberry
Roughleaf Dogwood

Southern Crab
Southern Waxmyrtle
Sumacs
Swamp Gallberry
Witherod Viburnum
Virginian creeper
Yaupon

PLANTS WITH COLORFUL FOLIAGE IN AUTUMN

Brook Euonymus
Common Sassafras

Flowering Dogwood
Roughleaf Dogwood
Sumacs

Virginian creeper
Virginia Sweetspire

PLANTS FOR VARIOUS SOILS

Best Adapted to Acid Soil

Coast Leucothoe	Mountainlaurel Kalmia	Red Chokeberry
Common Sweetshrub	Oakleaf Hydrangea	Sweetbells Leucothoe
Fetterbush Lyonia	Pinksterbloom Azalea	Virginia Sweetspire
Huckleberry		White Fringetree

Tolerate Wet Soils

American Cyrilla	Hazel Alder	Sweetbells Leucothoe
Buckweattree	Possumhaw Viburnum	Virginia Sweetspire
Common Buttonbush	Red Chokeberry	White Fringetree
Devilwood Osmanthus	Swamp Gallberry	Witherod Viburnum

Tolerate Dry Soil

American Beautyberry	Indiancurrant Coral- berry	Jersey Tea Ceanothus
Common Sassafras		Roughleaf Dogwood
Eastern Redbud	Indigobush Amorpha	Sumacs

PLANTS KNOWN BY THE AUTHOR TO BE
EASILY TRANSPLANTED

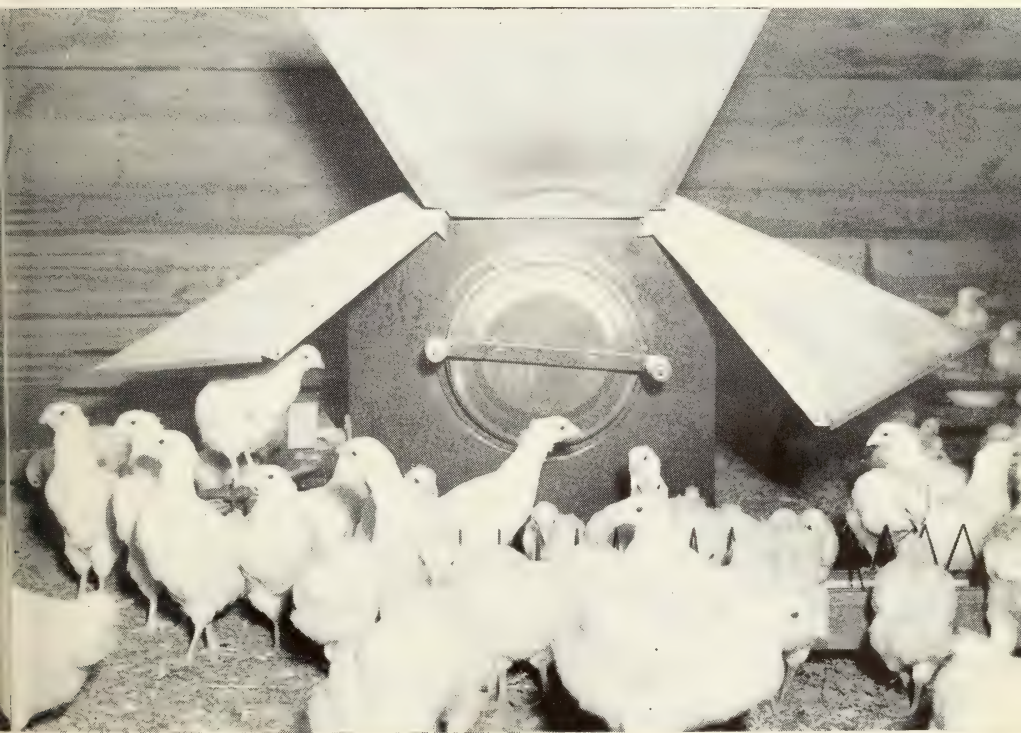
American Beautyberry	Indiancurrant Coral- berry	Possumhaw Viburnum
American Elder	Indigobush Amorpha	Red Chokeberry
Brook Euonymus	Laurel Greenbriar	Roughleaf Dogwood
Common Buttonbush	Nannyberry Viburnum	Sumacs
Common Sweetshrub	Pinksterbloom Azalea	Southern Crab
Fetterbush Lyonia	Possumhaw	Southern Waxmyrtle
Hazel Alder		Witherod Viburnum

PLANTS ADAPTED TO FREQUENT DRASTIC PRUNING

American Beautyberry	Common Buttonbush	Oakleaf Hydrangea
American Elder	Hazel Alder	Red Buckeye
Buckweattree	Indigobush Amorpha	Sumacs



BROILER PRODUCTION



e-5847

Compiled by H. O. WEST, Coordinator Research Information
Jointly Representing Mississippi Agricultural Experiment Station
and : : : : Mississippi State Vocational Board

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director

STATE COLLEGE

MISSISSIPPI

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BROILER PRODUCTION

Compiled by H. O. WEST*

Agricultural producers of the United States are faced with a situation at present never before equalled in the history of the world. Our agricultural producers are not only being asked to supply the food needs of our Nation but are having to send tremendous amounts of food to our allies. This condition may exist for several years. Producers are being urged to do everything possible toward increasing production of the major food items. This increase will have to be accomplished with less labor than is now available on farms.

Poultry produced for meat has been designated as a vital commodity. Producers are asked to increase production of this commodity by a considerable amount. To reach the increase that is being asked in poultry for meat, as well as other agricultural products, with less labor available, means that producers will have to use methods of production that require as little labor as possible, as well as economy and efficiency in all phases of production.

The production of broilers has been greatly increased during the last few years in Mississippi. This increase in production has brought about a large demand for information on the best practices to follow in producing broilers. There are a number of vital factors dealing with broiler production that should be thoroughly understood before a broiler production program is attempted. Some of these factors are: (1) Is broiler production profitable, (2) securing baby chicks, (3) housing and brooding, (4) feeding, (5) marketing, and (6) disease and parasite control.

Information is presented in this publication dealing with each of the above named factors. It is suggested that an individual, before attempting a broiler production program, should first determine the capital required, the amount of profit that can be reasonably expected, the necessary buildings and equipment, and provided the buildings and equipment. Many times an attempt is made to produce broilers with make-shift houses and equipment with disastrous results, which often discourages the producer to such an extent that the broiler production program is discarded. Information is presented in this publication that should help an individual decide whether or not profit can be expected from a broiler production program; also suggestions as to kinds of houses and equipment needed.

A careful study of the information presented in this publication should result in an individual being in a much better position to handle a broiler production program efficiently. The efficiency of most production programs determines to a large degree the success or failure of a given enterprise. It is hoped that the information presented in this publication will prove helpful to broiler producers in Mississippi.

*Jointly representing Mississippi Agricultural Experiment Station and Mississippi State Vocational Board.

Is Broiler Production Profitable?

In studying information on broiler production it was found that there was a very limited amount of information showing the cost of production of broilers in Mississippi. Due to this fact a study of broiler production in Smith, Rankin and Scott county areas was made in an effort to secure this type of information. Broiler and fryer production in Mississippi seems to be on a very definite increase, especially in the above mentioned area. It has been estimated that possibly one-half million broilers and fryers have been marketed from this area in 1939. A survey was made on 25 farms in this area involving approximately 30,000 broilers. The farms were visited to get actual conditions under which the chicks were produced. The broiler business in this section is promoted mainly by feed dealers. The feed dealers supply the farmers with the baby chicks and feed necessary to produce the broilers. In most cases this is a credit business. When the chicks are ready to market the feed dealer buys the chicks from the farmer, the chick cost and feed cost being deducted at the time of the sale. The feed dealer in turn markets the chicks in Jackson and New Orleans. Breeds used in this area are mostly Barred Rocks and White Rocks. Practically all the White Rocks are marketed in Jackson and a high percentage of the Barred Rocks are marketed in New Orleans. The number of chickens per farm ranged from 250 to 9,000. This variation in the number of chicks per farm was gotten in order that a comparison of the profit per pound with different number of chicks per farm might be made.

The housing conditions found in this area were ordinary. Most of the houses were boxed type, frame buildings with a large percentage having dirt floors. The approximate size was 16 feet x 16 feet per 500 chicks. On the farms using litter, peat moss was the source. The peat moss was put in the houses when the baby chicks were secured and the litter was not changed until the chicks were marketed. There were two types of brooders found in the study. Fifteen used thermostat control brooders and 10 used brick brooders. All used wood as the source of fuel. The farmers using the thermostat control wood brooders estimated about one-half as much wood was used in brooding as the ones using the brick brooders.

All farms in this study used commercial feed which consisted of battery mash and grain. The amount of feed used on each farm was ascertained from the feed store books.

The battery mash contained the following ingredients: Dried buttermilk, dried whey, meat scraps, selected fish meal, yellow corn meal, soybean oil meal, corn gluten meal, ground oat groats, pulverized heavy oats, wheat bran, wheat gray shorts, ground wheat, alfalfa leaf meal, fortified cod-liver oil, 2 percent calcium carbonate (from limestone), 1.80 of 1 percent manganese sulphate, and 1 percent salt.

The grain was chick grain and corn chops. On practically all farms the first feed given the chicks was chick grain. This feed was fed for three or four days. After this the chicks were fed all battery mash for four to six weeks. At this time the battery mash was supplemented with corn chops.

Table 1 shows a compilation of the surveys from this area. It should be noted from this tabulation that the cost per pound includes only the cost

of feed and the cost of chicks. The figures in this tabulation are prepared using present prices of feed, chicks, and prices paid for broilers. In using this information it will be necessary from time to time to adjust cost of feed, cost of chicks and value of chicks to the present market conditions in order to get an accurate picture.

Table 2 is a study or grouping of the above mentioned survey. The grouping was made on the basis of high, medium and low profit groups to show some of the facts that may influence the profit secured in producing broilers. It was thought wise to make a similar tabulation using experimental tests in order that a comparison of results under actual farm conditions to results from experimental tests might be made.

Table 3 represents a compilation of experimental tests. These tests were conducted in Alabama, Missouri, Mississippi, Indiana, and Delaware. In making this compilation the 1939 price of feed was used. In getting the cost of chicks the average paid by the Mississippi groups was used, also the average price per pound received by the Mississippi group was used in figuring the value of chicks. In reviewing the above tabulations a clear comparison can be made of the experimental tests to actual farm conditions.

In getting information on broiler production cost a report on a study of approximately 200,000 chickens by Purdue University was secured. It was thought advisable to include the results in terms of averages, of this study. Table 4 gives the results of this study made in Western Indiana, also the average of the Mississippi area and Experiment Station study. The Indiana study was made in 1935-1936, 1936-1937. The actual cost of feed and chicks during this period was used which might vary from prices of feed and chicks at any given time. These facts should be taken into consideration in making comparisons from this study. It will also be noted that the profit per pound per chick was higher compared to the Mississippi study. This average may be explained by the following fact. In the Mississippi area the price received averaged approximately 19 cents per pound and in Indiana in 1936 the average price was approximately 23 cents and, for 1937, the average price was 22.5 cents per pound. As stated above these facts should be taken into consideration in making a comparison. In this study approximately 225,000 broilers are involved which should give a fairly accurate picture of what to expect in the production of broilers under farm conditions.

Suggestive Questions

1. How much feed was required per pound gain in the Jackson Broiler Area?
2. How does the feed requirements in the Jackson Area compare with Experiment Station results?
3. What was the average percent mortality in the Jackson Area?
4. What determines the profit that is made on broilers?
5. How does the profit made per pound in the Jackson Area compare with Experimental results?
6. What type brooders were used in the Jackson Area?
7. According to results available are brick and oil drum brooders the most economical to use?
8. Is it possible to reduce feed cost by using home-mixed feeds rather than buying commercial mixed feeds?

Table 1 Summary of broiler production studies in Jackson, Mississippi, area.

Number chicks started	Mortality		No. chicks sold	Time fed Weeks	Av. wt. Lbs.	Amt. feed used			Total feed	Cost		Cost of chicks	Lbs. of chicks sold	Cost per lb.	Lbs. feed per lb. gain	Value of chicks*	Returns		Profit per lb.
	No.	Per- cent				Mash	Grain	Cost of mash		Cost of grain	Total cost						above cost		
800	120	15.0	680	11	2.45	3,400	1,700	5,100	\$ 102.00	\$ 42.50	\$ 60.00	\$ 204.50	1,615	12.6	3.15	\$ 323.00	\$ 118.50	7.3	
1,800	155	8.6	1,645	13	2.54	11,800	3,100	14,900	395.30	67.70	144.00	607.00	4,194	14.4	3.55	838.95	231.95	5.5	
1,050	32	2.4	968	11	2.00	5,800	1,500	7,300	188.50	30.75	80.00	299.25	1,996	14.99	3.66	399.20	99.95	5.0	
4,000	625	15.6	3,375	11	2.25	20,800	5,600	26,400	624.00	100.80	280.00	1,004.80	7,594	13.23	3.47	1,452.86	448.06	5.9	
2,100	332	15.8	1,768	11	2.22	13,400	300	13,700	398.30	25.50	147.00	570.80	5,912	14.37	3.47	768.69	197.89	5.0	
450	139	30.8	311	13	3.21	2,600	900	3,500	78.00	17.25	33.75	129.00	1,000	12.9	3.5	200.00	71.00	7.1	
500	136	27.2	364	12	2.67	2,600	1,100	3,700	78.00	21.50	27.50	137.00	975	14.05	3.79	195.00	58.00	5.94	
350	49	14.0	301	11	2.50	2,000	700	2,700	60.00	13.80	24.50	98.30	757	12.98	3.56	151.40	53.10	7.01	
500	59	11.8	441	11	2.48	2,400	1,000	3,400	72.00	19.80	35.00	126.80	1,095	11.57	3.10	219.10	92.30	8.42	
250	45	18.0	205	12	2.60	1,500	700	2,200	45.00	13.80	17.50	76.30	533	14.31	4.12	106.70	30.40	5.70	
500	33	6.6	467	13	2.97	3,000	800	3,800	90.00	14.40	40.00	144.40	1,389	10.39	2.73	250.02	105.62	7.60	
500	120	24.0	380	12	2.77	2,800	900	3,700	84.00	16.20	40.00	140.20	1,054	13.30	3.51	210.80	70.60	6.69	
500	16	3.2	484	12	2.92	4,100	1,300	5,400	123.00	23.40	37.50	183.90	1,415	12.99	3.81	254.70	70.80	5.00	
1,000	182	18.2	818	11	2.44	4,400	2,100	6,500	132.00	42.00	70.00	244.00	2,004	12.17	3.24	400.80	156.80	7.78	
950	74	7.7	876	11	2.02	4,300	1,500	5,800	129.00	30.00	66.50	225.50	1,778	12.65	3.26	346.75	121.25	7.26	
650	90	13.8	560	12	2.62	3,500	1,200	4,700	105.00	21.60	52.00	178.60	1,470	12.14	3.19	255.06	76.46	5.20	
200	22	11.0	178	13	2.88	1,100	500	1,600	33.00	9.60	16.00	58.60	514	11.40	3.11	92.52	33.92	6.59	
500	38	7.6	462	11	2.16	2,600	700	3,300	78.00	12.60	40.00	130.60	997	13.09	3.30	209.37	78.77	7.90	
500	45	9.0	455	13	2.55	2,500	1,000	3,500	75.00	18.00	40.00	133.00	1,161	11.45	3.29	208.98	75.98	6.54	
500	57	11.4	443	13	2.62	3,200	900	4,100	96.00	16.20	40.00	152.20	1,164	13.07	3.52	209.52	57.52	4.92	
1,000	152	15.2	848	11	2.38	4,400	1,500	5,900	138.00	28.00	80.00	246.80	2,024	12.19	2.51	394.68	147.88	7.30	
1,000	124	12.4	876	11	2.39	4,900	1,400	6,300	147.00	25.20	80.00	252.20	2,076	12.50	3.00	398.24	146.04	6.49	
500	52	10.4	448	11	2.16	2,600	700	3,300	78.00	12.60	40.00	130.60	997	13.09	3.30	209.37	78.77	7.90	
250	55	22.0	195	11	2.02	1,400	400	1,800	42.00	8.40	20.00	70.40	394	17.86	4.56	78.80	8.40	2.13	
9,000	1,275	14.1	7,725	12	2.64	54,000	10,800	64,800	1,620.00	274.00	720.00	2,614.00	20,471	12.76	3.16	3,684.78	1,070.78	5.23	
29,600	4,052	13.68	25,548	11.72	2.45	165,000	42,300	207,600	5,011.10	906.40	2,241.25	8,158.75	62,629	13.02	3.31	11,859.29	3,700.54	5.90	

*Price received per lb. 18 to 21 cents - an average of 19 cents per lb.

Table 2. High, medium, and low profit groups in the Jackson area.

No. chicks started	Mortality		No. chicks sold	Time fed Weeks	Average age wt.	Amt. feed used		Total feed	Cost of mash		Cost of grain	Cost of chicks	Total cost	Lbs. of chicks sold	Cost per lb.		Lbs. feed per gain	Value of chicks	Returns above cost	Profit per lb.
	No.	Per cent				Mash	Grain		lb.	chicks										
800	120	15.0	680	11	2.57	3,400	1,700	5,100	\$ 102.00	\$42.50	\$ 60.00	\$ 204.50	\$ 1,615	12.6	3.15	\$ 323.00	\$ 118.50	7.3		
450	139	30.8	311	13	3.21	2,600	900	3,500	78.00	17.25	33.75	129.00	1,000	12.9	3.5	200.00	71.00	7.1		
350	49	14.0	301	11	2.51	2,000	700	2,700	60.00	13.80	24.50	98.30	757	12.98	3.56	151.40	53.10	7.01		
500	59	11.8	441	11	2.48	2,400	1,000	3,400	72.00	19.80	35.00	126.80	1,095	11.57	3.10	219.10	92.30	8.42		
500	33	6.6	467	13	2.97	3,000	800	3,800	90.00	14.40	40.00	144.40	1,389	10.39	2.73	250.02	105.62	7.60		
1,000	182	18.2	818	11	2.44	4,400	2,100	6,500	132.00	42.00	70.00	244.00	2,004	12.17	3.24	400.80	156.00	7.78		
950	74	7.7	876	11	2.04	4,300	1,500	5,800	129.00	30.00	66.50	225.50	1,778	12.65	3.26	346.75	121.25	7.26		
500	38	7.6	462	11	2.16	2,600	700	3,300	78.00	12.60	40.00	130.00	997	13.09	3.30	209.37	78.77	7.90		
1,000	152	15.2	848	11	2.38	4,600	1,500	5,100	138.00	28.80	80.00	246.80	2,024	12.19	2.51	394.68	147.88	7.30		
500	52	10.4	448	11	2.16	2,600	700	3,300	78.00	12.60	40.00	130.60	997	13.09	3.30	209.37	78.77	7.90		
6,550	898	137.3	5,652	11.4	24.76	31,900	11,600	42,500	957.00	233.75	489.75	1,679.20	13,656	123.63	31.65	2,704.49	1,025.29	75.57 Total		
655	90	13.7	565	11	2.47	3,190	1,160	4,250	95.70	23.37	48.97	167.20	1,365	12.36	3.16	207.44	102.52	7.5 Av.		
1,800	155	8.6	1,645	13	2.54	11,800	3,100	14,900	395.30	67.70	144.00	607.00	4,194	14.4	3.55	838.95	231.95	5.5		
4,000	625	15.6	3,375	11	2.25	20,800	5,600	26,400	624.00	100.80	280.00	1,004.80	7,594	12.23	3.47	1,452.86	448.06	5.9		
500	136	27.2	364	12	2.67	2,600	1,100	3,700	78.00	21.50	37.50	137.00	975	14.05	3.79	195.00	58.00	5.94		
250	45	18.0	205	12	2.60	1,500	700	2,200	45.00	13.80	17.50	76.30	533	14.31	4.12	106.70	30.40	5.70		
500	120	24.0	380	12	2.77	2,800	900	3,700	84.00	16.20	40.00	140.20	1,054	13.30	3.51	210.80	70.60	6.69		
200	22	11.0	178	13	2.88	1,100	500	1,600	33.00	9.60	16.00	58.60	514	11.40	3.11	92.52	33.92	6.59		
500	45	9.0	455	13	2.55	2,500	1,000	3,500	75.00	18.00	40.00	133.00	1,161	11.45	3.29	208.98	75.98	6.54		
1,000	124	12.4	876	11	2.39	4,900	1,400	6,300	147.00	25.20	80.00	252.20	2,096	12.50	3.00	398.24	146.04	6.49		
8,750	1,272	118.0	7,478	9.7	20.65	48,000	14,300	62,300	1,481.30	272.80	655.00	2,419.10	18,121	104.64	27.84	3,504.05	1,084.95	49.35 Total		
1,093	159	14.7	934	12	2.58	6,000	1,787	7,787	185.16	34.12	81.87	302.38	2,265	13.08	3.48	438.00	135.61	6.16 Av.		
1,030	32	2.4	998	11	2.00	5,800	1,500	7,300	188.50	30.75	80.00	299.25	1,996	14.99	3.66	399.20	99.95	5.0		
2,100	332	15.8	1,768	11	2.22	13,400	300	13,700	398.30	25.50	47.50	574.80	3,942	14.47	3.47	768.69	197.89	5.0		
500	16	3.2	484	12	2.92	4,100	1,300	5,400	123.40	23.40	37.50	183.90	1,415	12.99	3.81	254.70	70.80	5.0		
650	90	13.8	560	12	2.62	3,500	1,200	4,700	105.00	21.60	52.00	178.60	1,470	12.14	3.19	255.06	76.46	5.2		
500	57	11.4	443	13	2.62	3,200	900	4,100	96.00	16.20	40.00	152.20	1,164	13.07	3.52	209.52	57.32	4.9		
250	55	22.0	195	11	2.02	1,400	400	1,800	42.00	8.40	20.00	70.40	394	17.86	4.56	78.80	8.40	2.13		
9,000	1,275	14.1	7,725	11	2.64	54,000	18,000	64,800	1,620.00	240.00	720.00	2,614.00	20,471	12.76	3.16	3,684.78	1,070.78	5.23		
14,030	1,857	82.7	12,173	8.2	17.04	85,400	23,600	101,800	2,572.80	399.85	1,096.50	4,069.15	29,382	98.28	25.57	5,650.75	1,581.60	32.48 Total		
2,004	267	11.8	1,739	11.7	2.43	12,200	3,371	14,542	367.54	57.12	156.64	581.30	4,197	14.04	3.62	807.25	225.94	4.64 Av.		

Table 3. Tabulation of experimental tests.

No. chicks started	Mortality		No. chicks sold	Time fed (Weeks)	Av. wt. lb.	Amt. feed used		Total feed	Cost of mash	Cost of grain	Cost of chicks	Total cost	Lbs. of chicks sold		Cost per lb. gain***	Lbs. feed	Value of chicks**	Returns above cost	Profit per lb.
	No.	Per cent				Grain	Mash						chicks	cost						per lb.	chicks**
275	28	10.0	247	8	.825	57.0	535*	570	\$ 9.85	\$20.62	\$30.47	\$30.47	201.8	15c	2.82	\$ 38.34	\$ 7.87	\$ 3.9c	
275	33	12.1	242	8	.655	179	535*	1,014	5.50	52.67*	20.62	28.70	159.0	18	6.4	30.21	1.42	.88	
275	29	10.4	246	8	.770	539	548*	1,087	7.25	2.74*	20.62	30.61	189.0	16.2	5.7	33.06	2.45	1.3	
275	50	18.5	225	8	.715	517	531*	1,048	6.97	2.65*	20.62	30.24	161.0	18.7	6.5	30.59	.35	.22	
275	35	12.8	240	8	.705	499	504*	1,003	6.05	2.52*	20.62	29.19	169.0	17.2	6.0	32.11	2.92	1.7	
1,669	155	9.6	1,469	12	1.93	10,364	1,953	12,317	240.36	28.31	125.17	898.84	2,922	13.4	4.2	555.18	161.34	5.5	
28	3	10.7	25	8	1.30	122.92		122.92	2.47	2.10	2.10	4.57	32.5	14.0	3.44	6.17	181.60	5.0	
28	1	3.5	27	8	1.75	147.23		147.23	3.20	2.10	2.10	5.30	47.25	11.2	3.10	8.97	3.67	7.8	
28	2	7.0	26	8	1.67	127.44		127.44	2.72	2.10	2.10	4.82	43.42	11.1	2.9	8.25	3.42	7.9	
30	2	6.6	28	8	1.62	126.33		126.33	3.18	2.25	2.25	5.43	45.36	11.9	2.6	8.62	3.19	7.1	
30	0	0.0	30	8	1.66	130.17		130.17	2.91	2.25	2.25	5.16	49.80	10.3	2.61	9.46	4.30	8.7	
30	0	0.0	30	8	1.32	113.65		113.65	2.85	2.25	2.25	5.10	39.60	12.8	2.86	7.52	2.42	6.2	
100	2	2	98	8	1.32	388		388	7.43	7.50	7.50	14.93	129.36	11.5	3.00	24.58	9.65	7.4	
100	2	2	98	8	1.51	435		435	8.87	7.50	7.50	16.37	150.90	10.8	2.88	28.67	12.30	8.1	
213	11	5.1	202	8	1.05	774		774	14.87	15.97	30.84	212.0	14.5	3.65	40.28	9.44	4.4		
213	19	8.9	194	8	1.31	836		836	16.23	15.97	32.20	254.0	12.6	3.29	48.26	16.06	6.3		
97	7	6.3	90	8	1.25	327		327	6.36	7.27	13.63	112.5	12.1	2.91	21.57	7.73	6.8		
97	7	6.3	90	8	1.34	332		322	6.75	7.27	14.02	120.6	11.6	2.75	22.91	8.89	7.3		
158	13	8.2	145	8	1.15	525		525	9.54	11.85	21.39	166.7	12.8	3.15	31.67	10.28	6.1		
265	40	15.1	225	8	1.26	831		831	15.82	19.87	35.69	283.5	12.5	2.93	53.87	18.18	6.4		
207	5	2.4	202	11	2.20	1,649		1,649	26.49	15.52	46.27	444.4	10.4	3.78	84.43	38.16	8.6		
207	8	3.9	199	11	2.39	1,682		1,682	29.72	15.52	49.28	475.6	10.3	3.63	90.36	41.08	8.7		
207	8	3.9	199	11	2.43	1,715		1,715	33.02	15.52	52.38	483.6	10.8	3.60	91.88	39.50	8.2		
207	17	8.2	190	11	2.46	1,675		1,675	34.73	15.52	53.70	467.4	11.5	3.69	88.80	35.10	6.5		
5,289	477	13.5	4,767	208	34.62	24,904.74		28,965.74	504.14	396.60	954.22	7,360.29	311.20	88.39	1,395.56	141.34	141.0	Total	
202	18	7.2	198	8.6	1.44	1,037.69		1,206.90	20.96	16.52	39.34	306.67	12.96	3.69	57.72	31.88	5.99	Av.	

*Skim milk.

**Used the average price of 19 cents per lb. received by Jackson area in computing value of chicks.

***In comparing the amount of feed per lb. gain in this tabulation, you will notice in the first test that skim milk was used, and that the skim milk was figured in the average lbs. of feed per lb. of gain which might have a bearing on the amount of feed required to produce a lb. of chick in this tabulation.

Table 4. Combined tabulation of Western Indiana area, Jackson area, and Experiment Station tests.

	No. chicks started	Mortality		No. chicks sold	Time fed Weeks	Av. wt. Lbs.	Total feed	Cost of mash	Cost of grain	Cost of chicks	Total cost	Lbs. of chicks sold	Cost per lb.	Lbs. feed per lb. gain	Value of chicks	Returns above cost	Profit per lb.
		No.	Per-cent														
Western Indiana area																	
1935-36	101,186	15,856	15.7	85,330		2.67	1,159,330	\$20,625.50	\$9,568.60	\$30,194.10	227,989	13.24	5,085	\$52,832.56	\$22,638.46	9.93	
1936-37	90,494	10,446	11.5	80,044		2.88	1,006,176	27,256.87	7,884.40	35,141.27	230,487	15.25	4,365	52,409.91	17,268.64	7.49	
TOTAL	191,680	26,302	13.6	165,374		2.77	2,165,506	47,882.37	17,453.00	65,335.37	458,476	14.24	4,725	105,242.47	39,907.10	8.71*	
Jackson, Mississippi area																	
	29,600	4,052	13.0	25,548	11.72	2.45	207,600	\$5011.10	\$906.46	2,241.25	8,158.75	62,629	13.02	3.31	11,859.29	3,700.54	5.90
Experiment Stations																	
	5,289	477	7.2	4,767	8.6	1.44	28,965.74	504.14	296.60	954.22	7,360	12.96	3.69	1,395.51	441.34	5.99	

*The profit per lb. in the Indiana tabulation is higher as compared to Jackson area. This is due to prices received for broilers. In 1936 the price was 23 cents per lb. and in 1937, 22 cents per lb. The Jackson area averaged 19 cents per lb.

Securing Baby Chicks

The factor of securing chicks is very important to the broiler producer. A great deal of care should be exercised to see that good healthy chicks are secured. They should be from blood tested flocks. In many instances chicks are bought that are infected with white diarrhea causing heavy losses to the producer.

There are several methods of securing chicks.

1. Hatching own eggs in incubator.
2. Having eggs hatched at hatchery.
3. Buying day-old chicks.

Table 5. Example of cost of chicks by different methods.

	Hatching at home in incubator*	Having eggs hatched at hatchery*	Buying day old chicks**
Kerosene	21 gals.	\$2.52	
Eggs	450 at 25 cents per dozen	9.38	100 at 25 cents per doz. \$2.08
Labor	21 hours at 10 cents	2.10	
Rent on incubator		2.50	
Having eggs hatched			2.50
Total cost		16.50	4.58
Percent hatchability	56 percent		56 percent
No. chicks hatched	252		56
Cost per chick	6.5 cents		8.1 cents 7.57 cents

*The prices used in this calculation should be secured for each locality and this calculation made. Taking an average of several tests the hatchability averaged 56 percent. This figure was used in this calculation.

**The average cost of chicks in Jackson area.

Comparison of cost of purchased chicks with farm-hatched chicks.

Year	Purchased chicks cost per 100	Farm hatched chicks cost per 100
1933-34	\$7.73	\$6.35
1934-35	8.75	8.10
1935-36	9.48	6.57
3 year average	\$8.65	\$7.00

These are the results of a study made in Indiana in comparing purchased chicks with farm-hatched chicks.

Suggestive Questions

1. What is the best way of securing chicks?
2. What risks are involved in hatching own chicks?
3. How does hatching own chicks compare with buying day-old chicks?
4. What risks are involved in having eggs hatched at hatchery?
5. Will enough money be saved in hatching own chicks to overcome risk involved?
6. By what method may best quality chicks be secured.

Housing and Brooding

HOUSING

According to the chart of broiler prices for a 10-year period, the highest prices are received in March, April, and May. If broilers are to be marketed during the peak price months, it will be necessary to start the chicks during the winter months which makes it necessary that suitable houses be made available to protect the chicks from the cold. In some instances individuals have tried to produce broilers without sufficient houses, resulting in the loss of entire flocks of chicks. Such an experience may cause the producer not to attempt the production of broilers in the future.

There are a number of different types of houses that can be used satisfactorily. The type of house used is not so important; the main object is to provide a house that is economical to build and will afford protection to the chicks, taking into consideration the good qualities a house should have. The size house will depend on the number of chicks to be produced. Do not build a house for large units. It is the opinion of many poultrymen that a unit should be from 250 to 400 chicks. Unless several thousand chicks are produced, it is thought advisable to use colony type houses in order that the houses can be separated, thereby reducing the danger of disease.

The following points should be considered in constructing a brooder house.

1. Location: Careful consideration of the place to locate a brooder house is essential to successful brooding. It should not be located close to hog pens or other livestock buildings.

The soils should be well drained. A brooder house on poorly drained soil causes a damp house which is very bad on chicks. The house should be placed where shade is available, without cutting out direct sunshine. Sunshine is very necessary in growing young chicks as it supplies vitamins and helps disinfect the house. The house should face the south if possible allowing a maximum of sunlight to enter.

2. Size: Number of chicks to be brooded should be considered in figuring size of the house. Crowding chicks causes many brooding failures.

3. Ventilation: A poorly ventilated house is damp, close and unhealthful for chicks. Ample ventilation is necessary to remove the moisture which the fowls have exhaled, and also odors and gases. Ample ventilation should be gotten without having drafts. Drafts on young chicks often causes roup or colds which may be serious at times.

4. Sunlight and dryness: Good ventilation, drainage, and plenty of sunlight are essential in keeping the house dry. A dry house is very important, because the chicks give off body moisture in the breath, and this moisture should pass out.

Sunlight is far better than any disinfectant in destroying disease germs.

To construct a brooder house a plan or blue print will be needed. The plan of a brooder house has been worked out by the Poultry Department of the Mississippi Extension Service. The plan is for a 10' x 12' portable brooder house and is illustrated in figure 1, 2, 3 and 4.

Suggestive questions

1. Where should the brooder house be located?
2. What should determine the size brooder house to build?
3. What points should be considered in building a brooder house?

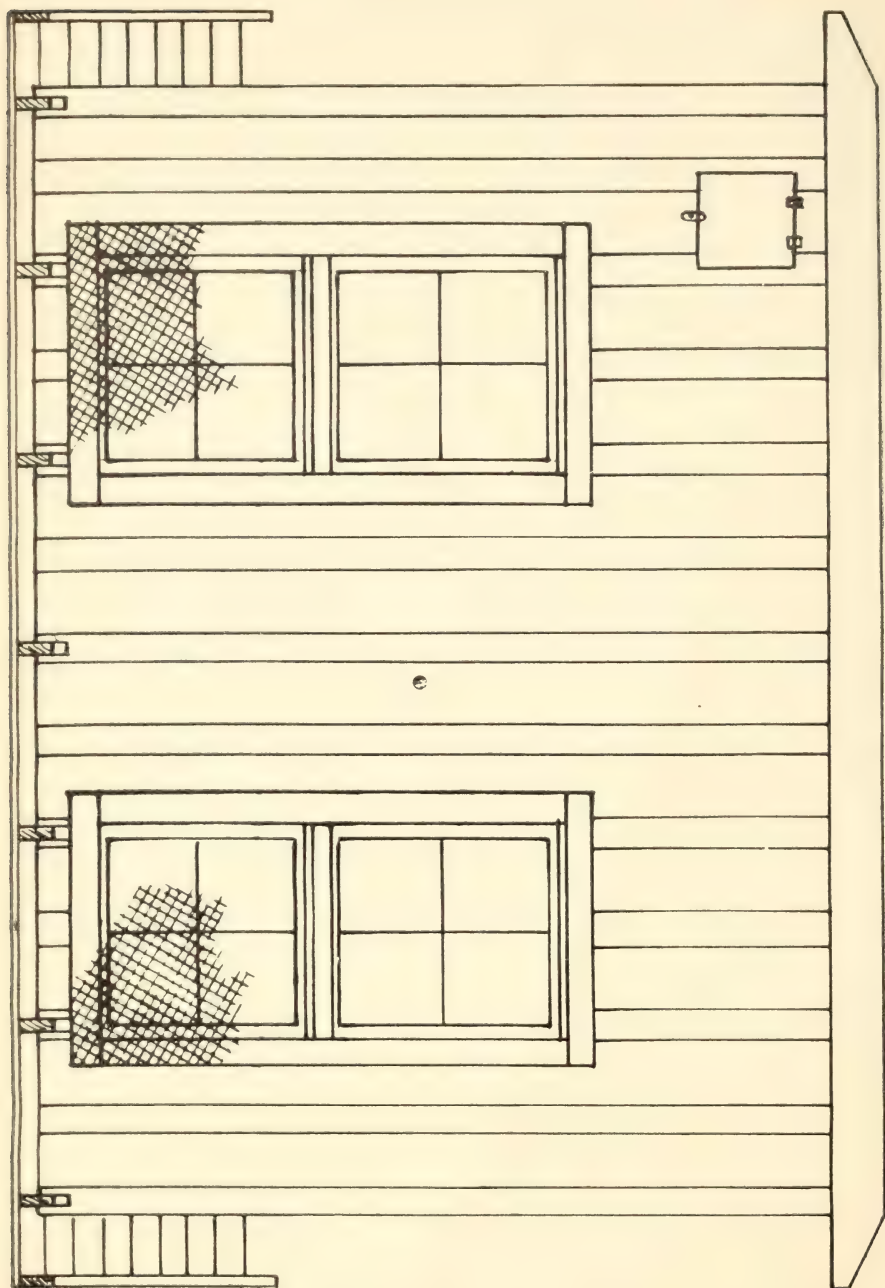


Figure 1. Mississippi type brooder house. See page 16 for bill of material.
FRONT ELEVATION

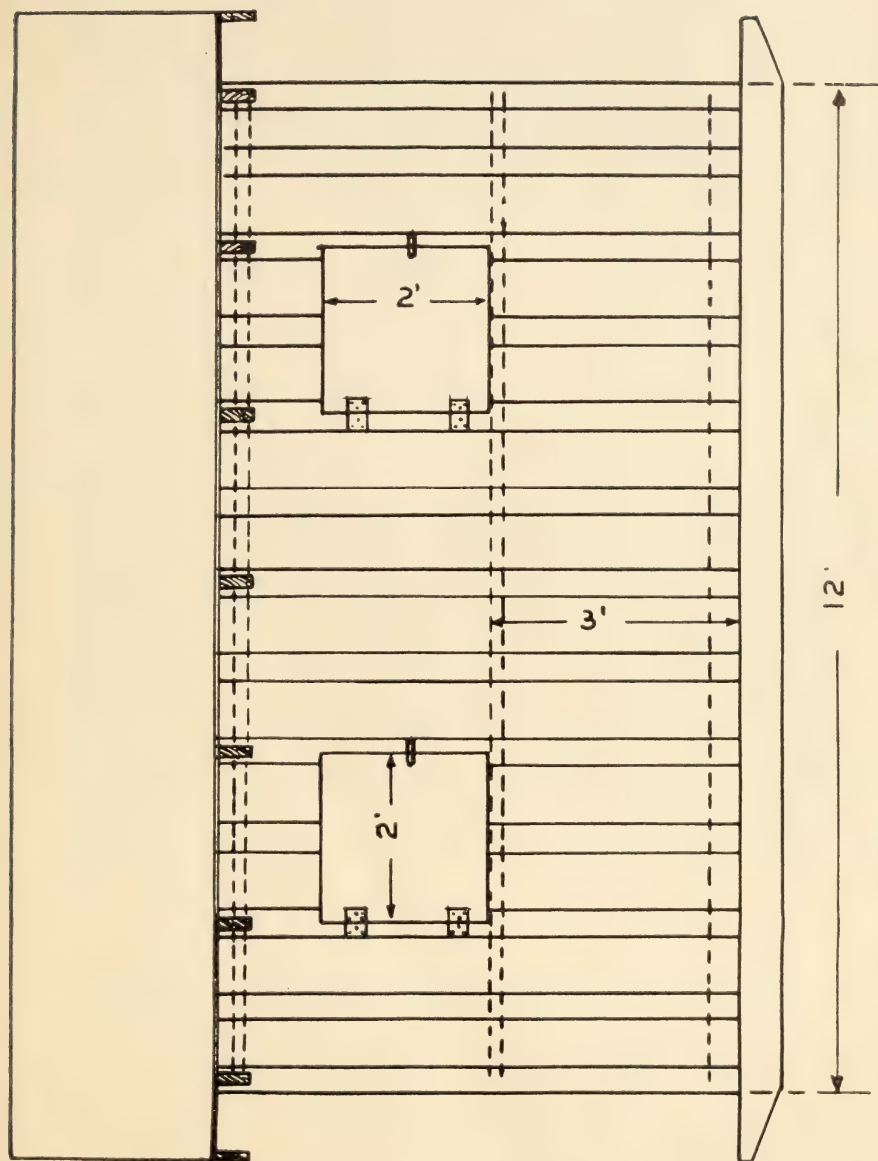


Figure 2. Mississippi type brooder house. See pages 15 and 16 for bill of material.
BACK ELEVATION

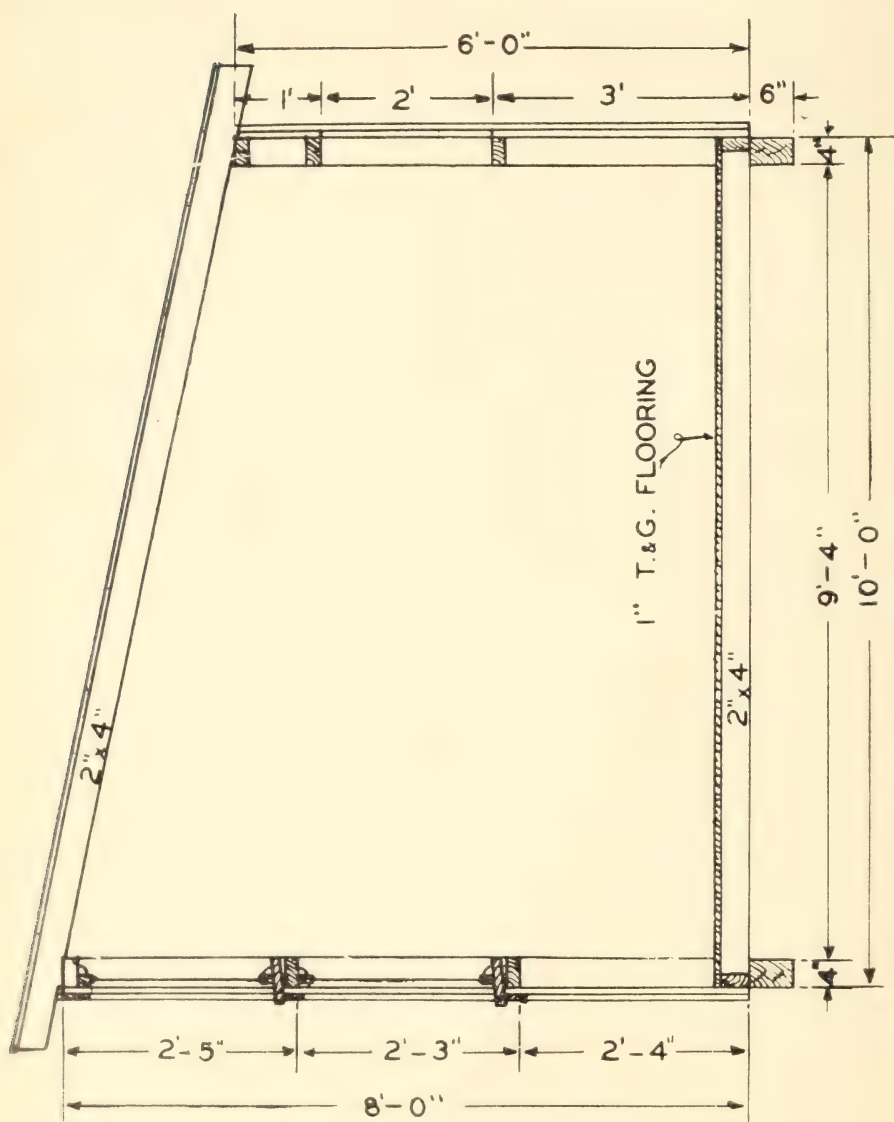


Figure 3. Mississippi type brooder house. See pages 15 and 16 for bill of material.

CROSS SECTION

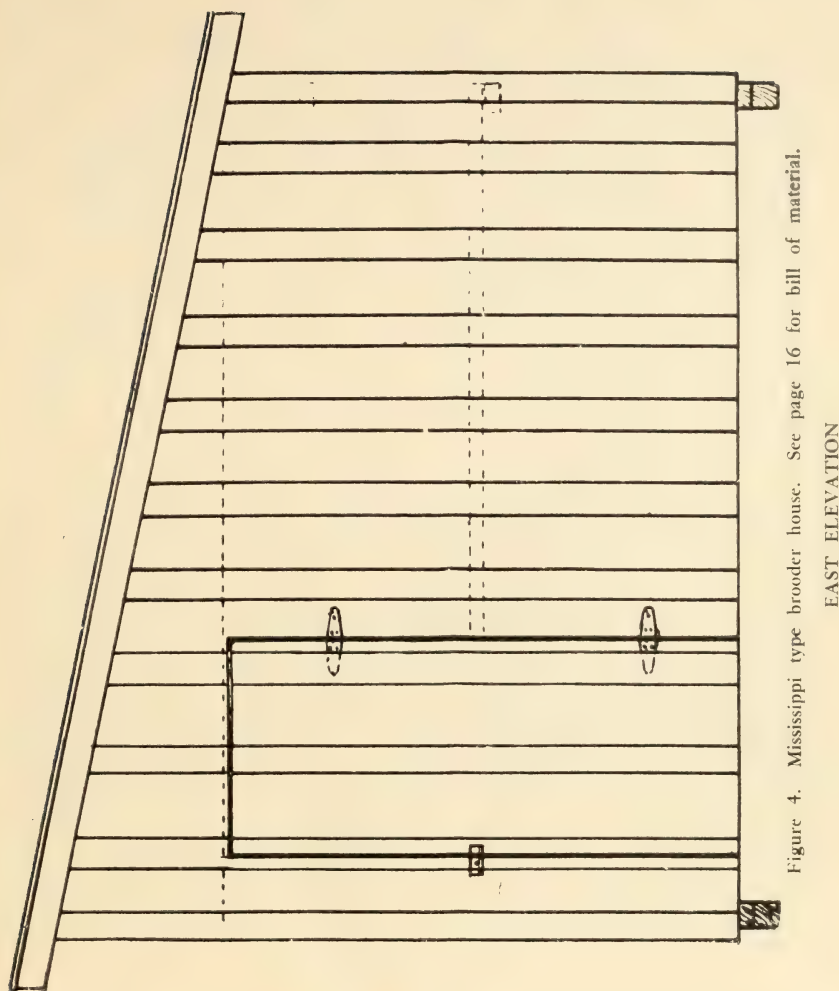


Figure 4. Mississippi type brooder house. See page 16 for bill of material.

EAST ELEVATION

The following bill of material is suitable for the 10x12-foot house as shown in figures 1, 2, 3 and 4. Blue prints giving detailed information on house construction may be obtained by writing the Mississippi Extension Service, State College, Mississippi.

Runners		Front	
2	4" x 6"—14'	4	2" x 4"—12'
Floor joints		2	2" x 4"—18'
7	2" x 4"—10'	5	1" x 12"—16'
Roof		6	1" x 4"—16'
7	2" x 4"—12'	Perches	
21	1" x 8"—14' shiplap	6	2" x 2"—12'
13	pieces 6 foot V crimped galvanized iron roofing no less than 29 gauge or 1½ squares composition roofing.	Windows	
		4	frames—24" x 26" to fit front openings.

Bill of material (continued)

	Floor	Hardware
40	1" x 4"—12' flooring	4 door latches
	Ends	1 pair 6" strap hinges for east door
4	2" x 4"—10'	3 pair 4" strap hinges
10	1" x 12"—16'	15 lbs. 8d nails
10	1" x 4"—16'	5 lbs. 16d nails
	Back	10' 20" wide 1" mesh poultry netting
4	2" x 4"—12'	Paint
6	1" x 12"—12'	1 gallon ready mixed house paint.
6	1" x 4"—12'	

Brooder Houses Being Used in Mississippi

In broiler producing areas many different type brooder houses are used. The pictures shown in figures 5, 6, 7 and 8 illustrate the variations found in housing conditions. These pictures were taken in Scott, Newton and Monroe Counties, Mississippi.



Figure 5. An old dwelling converted into a brooder house.

Death Rate of Chicks As Affected by Floor Area Allowed

The floor space per 100 chicks started averaged 33.2 square feet. The floor space varied from 26 to 80 square feet per 100 chicks started on the farms included in the study. Eighty-three percent of the lots were produced on floor space ranging from 30 to 60 square feet per 100 chicks started. The death loss averaged 24 percent for lots produced with less than 30 square feet of floor space per 100 chicks started. The death loss was 8.5 percent for lots produced with 30 to 60 square feet and 7.0 percent for lots with over 60 square feet of floor space per 100 chicks started.

Reference: Mimeograph, "Cost of Producing Broilers in Western Indiana, 1936-1937," Purdue University, Agricultural Experiment Station, Lafayette, Indiana.

Table 6. Death rate of chicks as affected by floor area allowed.

Floor area per 100 chicks	Number of chicks	Chicks died	Percent died
35 square feet or less.....	73,077	19,254	26.3
35-50 square feet	25,371	4,122	16.2
50 square feet or more	25,044	3,484	13.1

Reference: California Agricultural Extension Circular 28, "Brooding and Pullet Management," by W. E. Newton and M. W. Buster.

Feather Condition of Eight-Week-Old Chicks

Conducted by: Pennsylvania Agricultural Experiment Station.

Conducted at: State College, Pennsylvania.

Period: December 5, 1940 to January 31, 1941.

Purpose: To observe the feather condition of eight-week-old Barred Plymouth Rock chicks.

Procedure and Conditions: Chicks were brooded for the 8-week period in 10 x 12 foot colony brooder houses, no sun porches or ranges were used. In the test, 1,766 chicks were brooded in 4 paired groups, brooder allowance per chick being 7, 11, 15, and 19 square inches for each pair of groups.

Penn State chick starter was fed for 4 weeks, insoluble grit being sprinkled on the mash whenever feeders were filled. After that time starter mash and intermediate size grain, equal parts of wheat, and cracked yellow corn were fed free choice. Day-old un-sexed chicks were used.

It is generally known that in most of the heavier breeds of chickens, feather growth is slower than in Leghorns. There is also a sexual difference in rapidity of feather growth, female plumage developing more rapidly than male. Differences in completeness and condition of feathering between groups and between sexes were so obvious at the 4-week weighing that it was decided to score all birds as excellent, good, fair, poor, or bare, according to the apparent development of feathers and completeness of plumage covering. The grades indicated are somewhat more detailed than market grades which are more nearly comparable to the combined grades used in the groups of figures 2, 3, and 4.

Table 7. Feather condition scores at eight weeks of age; Barred Plymouth Rock chicks hatched December 4, 1940—Pennsylvania.

Group number	Brooder space per chick	Original number of chicks	Feather condition scores*			
			Females	Males	Average	Difference F & M
	Sq. in.					
1	19	132	98.63	79.30	94.97	19.33
9	19	132	96.97	84.14	90.56	12.83
10	15	167	95.00	73.25	84.13	21.75
12	15	167	96.39	75.00	85.70	21.39
3	11	227	87.89	56.76	72.33	31.13
11	11	227	87.85	66.42	77.14	21.43
2	7	357	72.41	50.12	61.27	22.28
4	7	357	76.53	50.12	62.33	26.41

*Basis of individual scores: Excellent equals 100; Good equal 80; Fair equals 60; Poor equals 40; Bare equals 20.

Reference: Pennsylvania Agricultural Experiment Station Bulletin 410, "Electric Brooding under Winter Conditions," pages 2, 3, and 15, table 9, State College, Pennsylvania, November 1941.



Figure 6. A large commercial type house. This house has ten 500 capacity units.



Figure 7. A combination battery type house. The chicks are started in rows with automatic oil burner brooders and remain there for 4 weeks. The chicks are then transferred to the battery as shown in figure 9.



Figure 8. Brooder house with two 500 capacity units, with a feed room between the units.

BROODING

Brooding is one of the most important points in broiler production. No matter how good the breeding or how carefully the eggs have been incubated, profitable broilers will not be developed unless they have been well cared for during the brooding period.

Successful chick brooding demands close attention to a few simple details. More careful attention is required the first few days than later, but careful attention is required throughout the brooding period.

Before a group of baby chicks are put in the brooder house it should be cleaned and thoroughly disinfected, repeating this practice after each group of broilers has been marketed.

Brooders: It is advisable to start the brooder stove two or three days be-



Figure 9. Chicks being finished in battery, no artificial heat supplied.

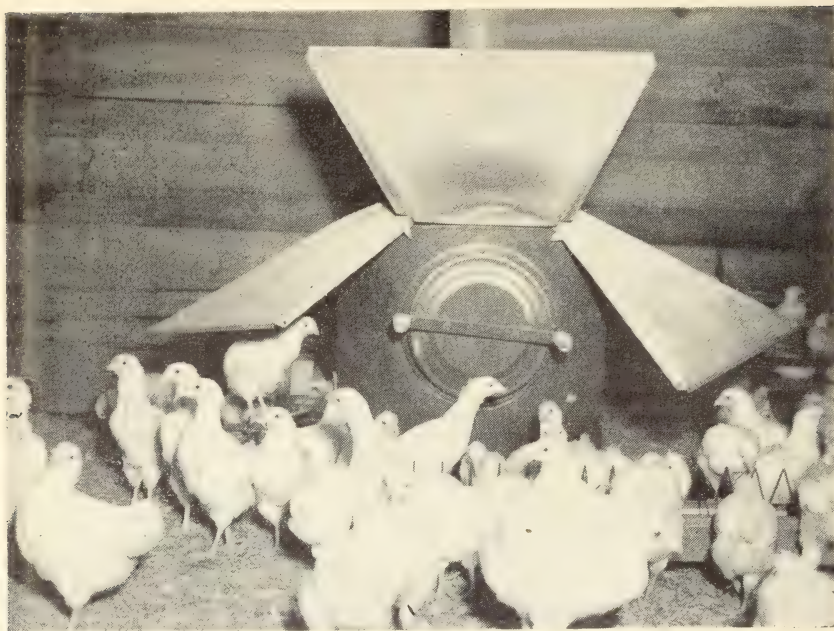


Figure 10. Thermostat-controlled wood burning brooder.

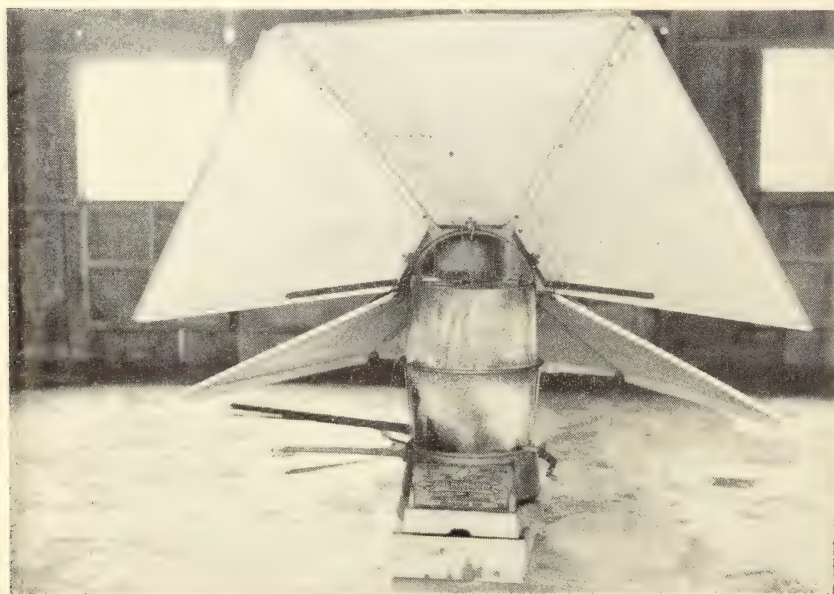


Figure 11. Thermostat-controlled coal burning brooder.

fore the chicks are put in the house to assure perfect adjustment and safety of the stove. It is unsafe to lay down absolute rules for running a brooder

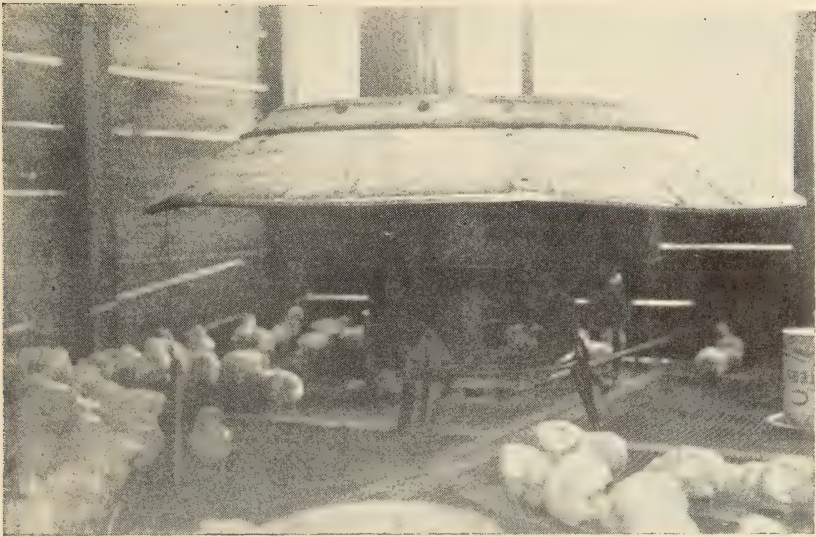


Figure 12. Thermostat-controlled oil burning brooder.

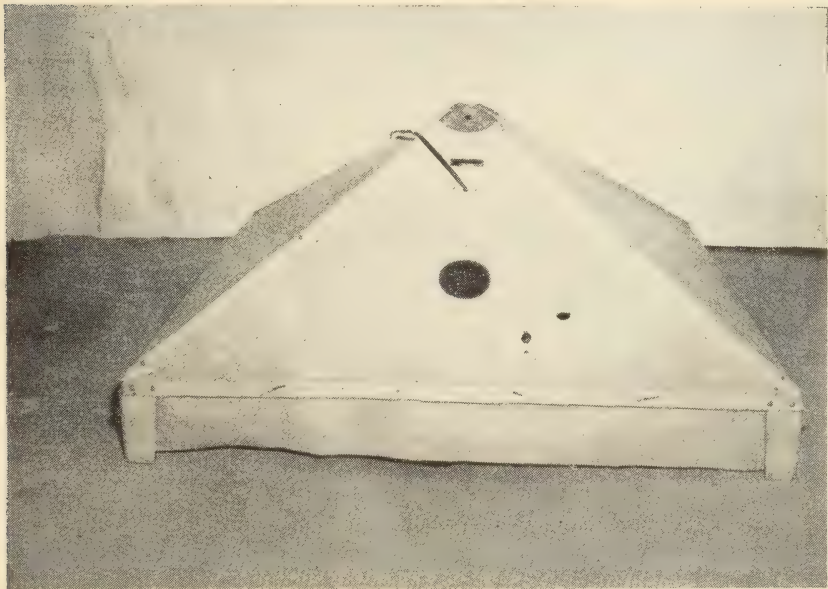


Figure 13. Thermostat-controlled electric brooder.

stove. However, most poultrymen regulate the stove to give a thermometer reading of about 90 to 95 degrees F. when the bulb is 2 inches from the floor at the edge of the canopy. For brooders that have no canopy, the same temperature should be kept when the thermometer hangs 20 to 30 inches from the edge of the brooder stove. The temperature should be lowered about five de-

greens each week until about 70 degrees F. is reached and the house kept at this temperature as long as the chicks need artificial heat. The stove is regulated up or down as the case may be when the chicks are placed in the house. First and always the chicks must be comfortable.

The experienced poultryman depends almost entirely upon the action of the chicks in regulating the stove. If chicks pile up or bunch because they are uncomfortable, they may be too warm or too cold, or the floor may be drafty. When they are comfortable and normal the sleeping chicks will lie stretched out on the litter. They will spread out in a circle around the outer edge of the hover in the most comfortable heat area.

There are a number of different types of brooders in use at the present time in Mississippi. A few years ago the type most frequently used was the oil drum and brick type brooders. These type brooders are objectionable due to the enormous amount of fuel required, and the irregularity of temperature.

The oil drum and brick type brooders are being replaced in many instances with thermostat-controlled wood brooders, illustrated in figure 10; thermostat-controlled coal brooder, illustrated in figure 11; thermostat-controlled oil brooder, illustrated in figure 12; the electric brooder, illustrated in figure 13; the new electric lamp brooder, illustrated in figure 14; and the home-made chick brooder where a small number of chicks are to be raised, illustrated in figure 15. The thermostat-controlled brooders make it possible to maintain a much even temperature and also use less fuel. It is estimated that the thermostat-controlled wood brooder will not use more than one-third the amount of wood as the oil drum and brick brooder. A constant temperature is very important in producing broilers, especially when the chicks are very young, therefore, a broiler producer may well justify the expense of replacing

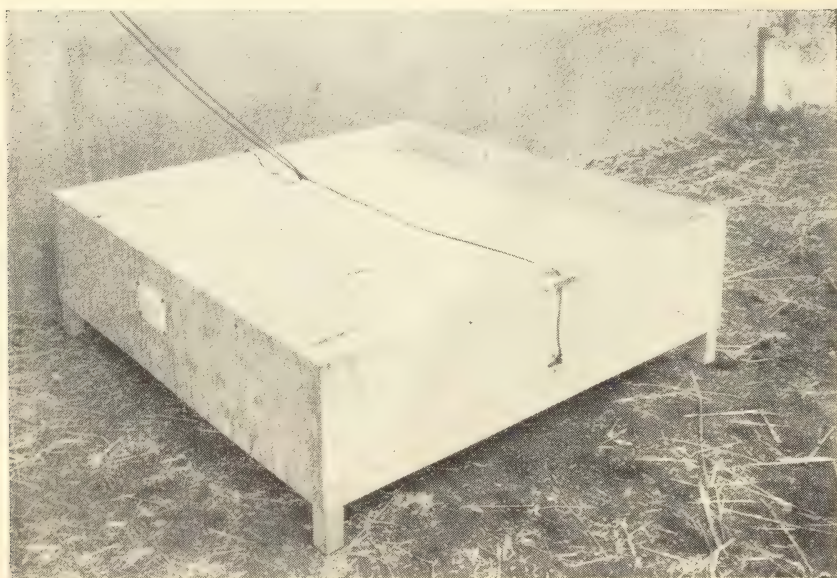


Figure 14. New electric lamp brooders.

an oil drum or brick brooder with one of the thermostat-controlled or automatic type brooders.

New Electric Lamp Brooder*

This type chick brooder was designed by Mr. D. C. Kennard and Mr. V. B. Chamberlin of the Ohio Agricultural Experiment Station and was first used by the Ohio Station in October 1940. The 4' x 4' hover will accommodate 150 to 250 chicks. The brooder is operated on the basis of the behavior and comfort of the chicks by the regulation of heating electric lamps, rather than by thermostatic heat control. The chicks will readily adapt themselves to their heat requirements and comfort in a brooder of this kind.

This type brooder is simple to construct and requires very little material. This type brooder is illustrated in figures 14 and 16.

The following materials are needed to construct a 4' x 4' brooder:

- 1 piece of 4 x 8 foot, $\frac{1}{2}$ " plywood or $\frac{1}{8}$ " pressed wood (to be cut into one 4 x 4 foot top and four 1 x 4 foot sides.)
- 4 cleats 1" x 1", 4 feet long, to which the top and sides are nailed.
- 4 pieces of $1\frac{1}{2}$ " x $1\frac{1}{2}$ " lumber, 16 inches long, for corner posts or legs
- 2 porcelain electric lamp bulb sockets (Porcelain lamp sockets are necessary for these lamps.)
- 1 150-watt, 115 or 130 volt projector or reflector Mazda spot or flood lamp and
- 1 250-watt R-40 Bulb drying lamp.
- 20 feet of rubber-covered electric appliance cord with plug and cap.

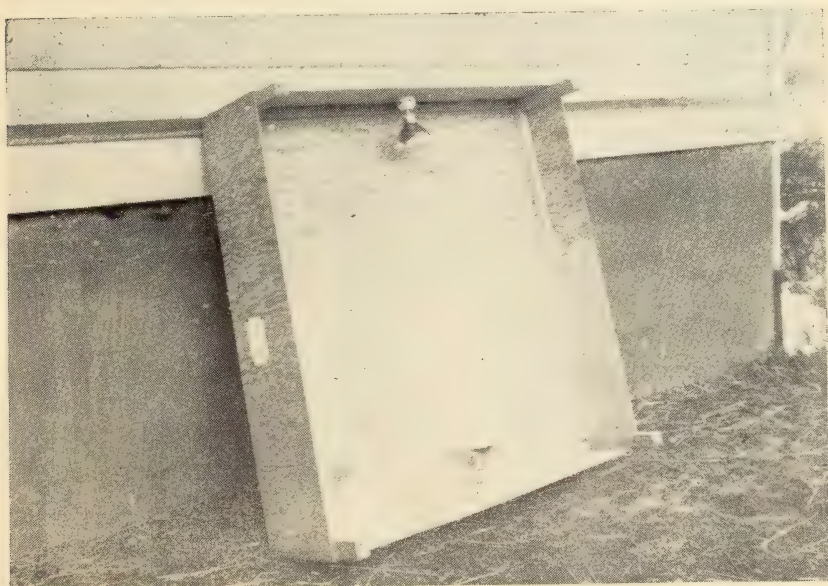


Figure 15. Inside of the 4 x 4-foot hover.

Home-made Chick Brooder

The home-made chick brooder is very convenient where a small number of chickens are to be brooded. Not more than 50 chicks should be placed

*Ohio Agricultural Experiment Station Special Circular 63, "New Electric Lamp Brooder," by D. C. Kennard and V. D. Chamberlin.

in a brooder of this type, the size as illustrated below. This type brooder is very easy to construct and can be made mostly from scrap materials. Figures 17, 18, 19, 20, and 21 illustrate the different parts of the brooder. It should be pointed out that a brooder of this type may not be as economical as colony brooding, especially if several hundred chicks are to be produced.

This type of brooder is heated by placing a lamp in the lower section of

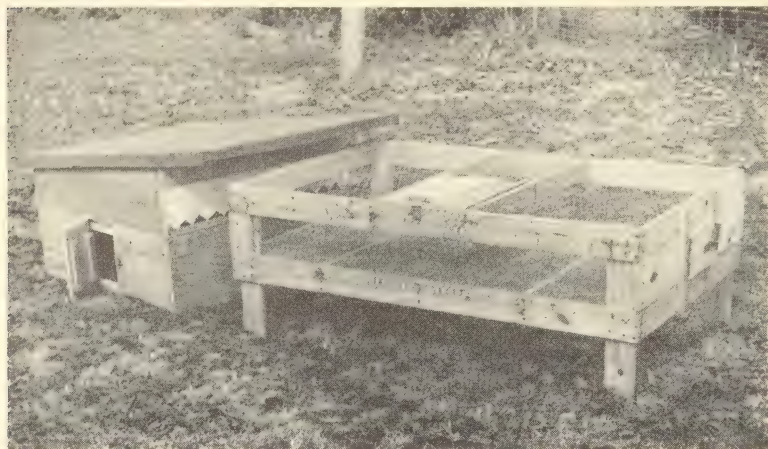


Figure 16. Home-made chick brooder.

Bill of material for brooder and sun porch.

Lumber	Hardware
1 piece 1" x 12" x 12'	2 pairs 1½" butt hinges
1 piece 1" x 12" x 6'	1 pair 2" butt hinges
1 piece 1" x 8" x 12'	3 5-inch hasps
1 piece 1" x 8" x 16'	1 piece no. 28-gauge galvanized iron 33" x 34"
1 piece 1" x 6" x 6'	1 piece ½" mesh hardware cloth 36" x 5'
3 pieces 1" x 4" x 16'	1 piece 1" mesh chicken wire 36" x 10'
1 piece 1" x 4" x 14'	1 lb. 6-penny box nails
1 piece 1" x 4" x 12'	½ lb. poultry wire staples
1 piece 1" x 4" x 8'	7' 36-inch composition roll roofing
1 piece 2" x 2" x 7'	½ lb. flat head roofing nails
1 piece 1" x 1" x 16'	25 3/8" corrugated wood fasteners
Important: All lumber should be no. 2 dressed.	1 piece heavy cloth 6" x 36"

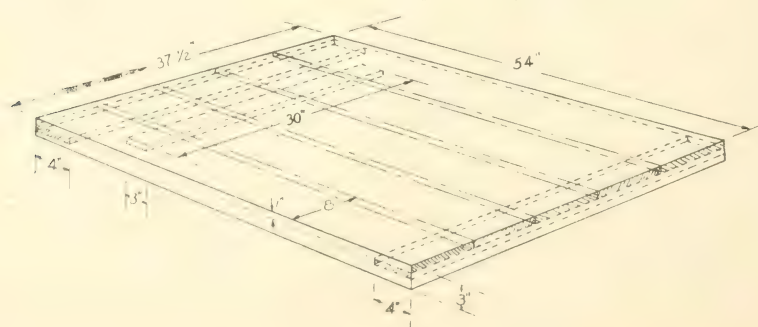


Figure 17. Roof of brooder.

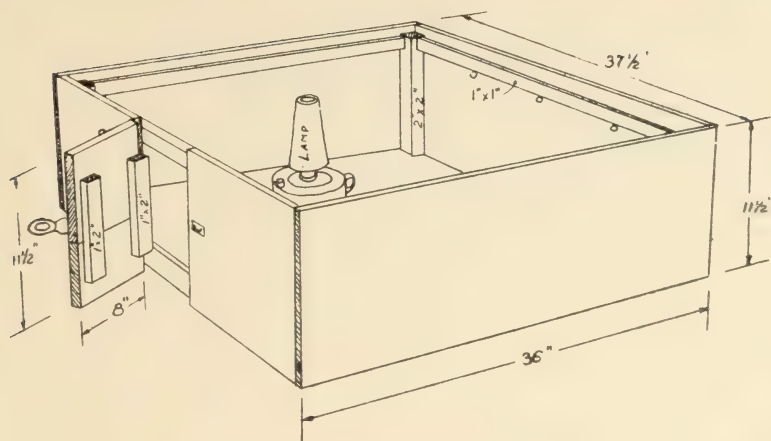


Figure 18. Lower section of brooder.

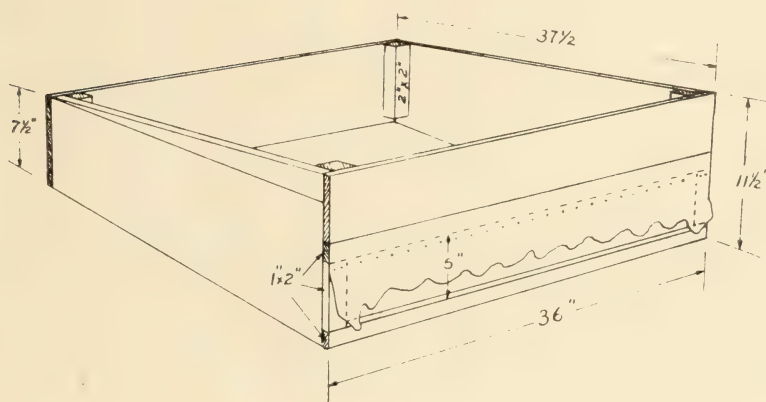


Figure 19. Upper section of brooder.

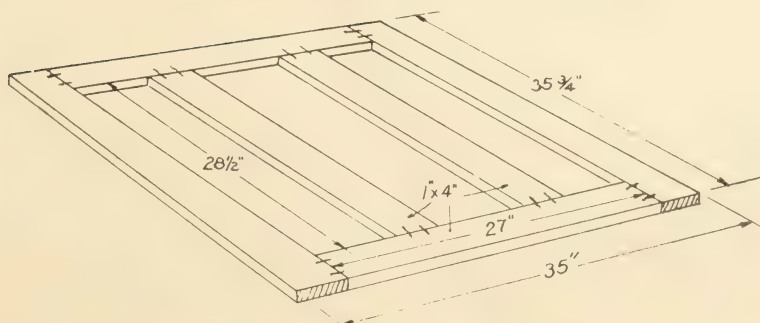


Figure 20. Chick tray.

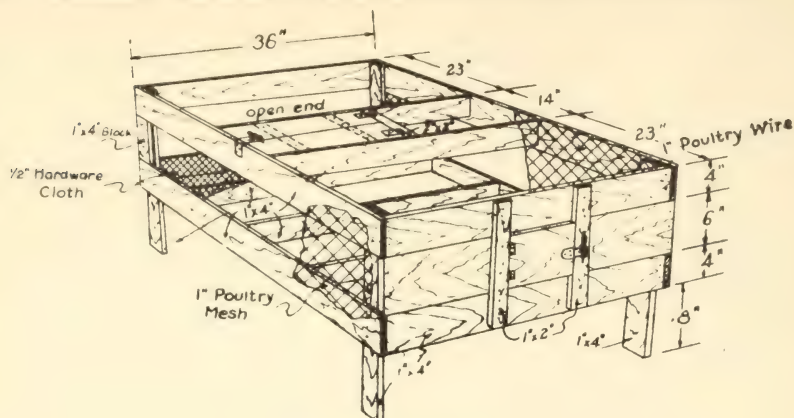


Figure 21. Sun porch.

the brooder which heats the tin and sand on the chick tray which gives off heat for the upper section where the chicks are located.

The plans for this type brooder were prepared by the Poultry Department, Mississippi Extension Service, State College, Mississippi. Plans for the brooder with steps in construction can be secured by writing Mississippi Extension Service, asking for Extension Circular 113, "Chick Brooder."

Litter: Where the chicks are brooded on wood or concrete floors it is very essential that some kind of litter be used. The litter should be two or three inches deep over the entire floor of the brooder house. Many kinds of litter are used satisfactorily, including planer shavings, pine needles, peanut hulls, sand, oat or wheat straw, peat moss and ground cane pumice.

Feeding: Chicks hatched on the farm should be fed when they are 24 to 48 hours old. Chicks shipped from a distance should be fed on arrival. Recent experiments have shown that it is safe to feed chicks as soon as they are placed in the brooder house. Chicks hatched on the farm will usually be 24 hours old by the time they are removed from the nest or incubator. The chicks can be fed at intervals or the feed can be left before the chicks from the start. Feed fresh mash each day to stimulate feed consumption. When

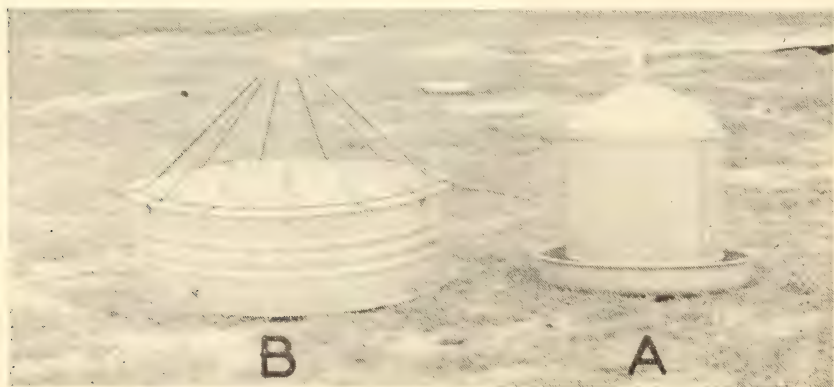


Figure 22. Two types of chick waterers.

chicks are about 6 weeks old begin feeding grain in addition to mash.

Water and milk: Give the chicks as much water and milk as they will drink beginning with the first feeding. The use of a one-half gallon fruit jar inverted in a small saucer or star top is a satisfactory way of supplying water for young chicks under farm conditions. Where large numbers of chicks are produced, supplying water in one-half gallon fruit jars may become rather burdensome. The waterers illustrated in figure 22 should prove very helpful in supplying chicks with water. Use the waterer shown in figure 22-A for small chicks and the one shown in figure 22-B when the chicks have grown larger. The fountains should be placed on bricks to prevent water or milk from becoming contaminated with dirt and droppings. During the first few weeks it will be necessary to supply fresh, clean water two or three times each day.

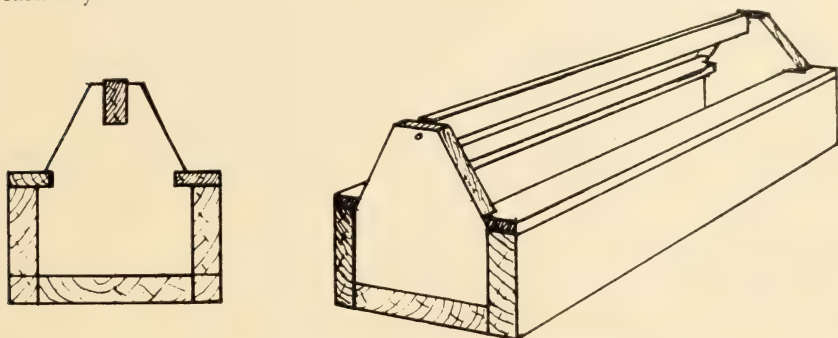


Figure 23. A satisfactory design for home-made chick feeder.



Figure 24. Purchased chick feeders.

Feed hopper: The type of mash hopper used and the amount of hopper space are important factors in the growth of chicks. To prevent the spread of diseases and parasites, it is highly important that a mash hopper be used which will prevent the chicks from getting in or roosting on it. Figures 23 and 24 illustrate satisfactory types of feed hoppers.

Suggestive Questions

1. In what condition should the brooder house be when the chicks are put in?
2. What type brooder stove is best to use?
3. How should the brooder stove be operated?
4. When should the brooder stove be started with a group of baby chicks?
5. What temperature should be maintained in the house?

6. What is the purpose of litter on the brooder house floor?
7. When should the chick receive the first feed?
8. What type feed hopper should be used?
9. What effect does the number chicks brooder together have on percent mortality?

Comparison of Different Type Brooders

Conducted by: Virginia Agricultural Experiment Station.

Conducted at: Blacksburg, Virginia.

Period: November 21, 1935 to January 30, 1936.

February 11, 1936 to April 7, 1936.

April 28 to June 23, 1936.

Purpose: To compare the different type brooders.

Procedure and Conditions: Six brooder houses approximately 9' x 12' in dimensions were used in the tests. The houses were not insulated and they had single thickness tongue and grooved floors. Ventilators were arranged so that the same principle of ventilation was used in all houses.

The same brand and grade of starter and growing mash was used throughout the tests. Feed was kept in the hoppers at all times so that variations in brooding results could not be attributed to the feed.

FIRST SERIES

The following brooders were used in these tests: Commercial electric hover with forced ventilation; commercial electric hover with natural ventilation; kerosene brooder with hover converted for electric operation and natural ventilation; flat top home-made electric brooder; commercial coal brooder; and commercial kerosene brooder.

Twelve hundred Virginia state certified Barred Plymouth Rock chicks were received from the hatchery at 5:00 P. M., November 19, and were placed under the four electric brooders for the night. The kerosene and coal brooders were ready for use the following morning and the chicks were subdivided and 200 were placed under each of the six brooders. Small lights were burned in the coal and kerosene brooder houses at night. After December 9, lights were burned at night in all the electric houses but were not used for the first few weeks because of the danger of attracting the baby chicks from under the hover at night. A tin screen was placed around the electric hovers for the first week to prevent the baby chicks from wandering too far from the hover.

During the 10-week period of this brood the weather was severe. The average outside temperature for the entire period was 29.8° F. The lowest temperature during the period was 7° F., and the highest was 56° F. The only difficulty encountered in the electric brooder houses was that of the water freezing in the drinking fountains on extremely cold nights. A home-made electric warmer was devised using a 25-watt light bulb. One of these warmers placed in each water pan prevented the water from freezing.

SECOND SERIES

In this series of tests the converted electric brooder was omitted, and a new type wood-burning stove was substituted for it. The wood burner consists of a cast iron fire box with a sheet metal canopy. The damper is controlled by a wafer type thermostat and the new feature of the brooder is the

Table 8. Comparison of different types of brooders.

Type brooder	1st Test—10 Weeks				2nd Test—8 Weeks				3rd Test—8 Weeks						
	No. chicks started	No. chicks reared	Percent mortality	Average wt. per chick	Fuel consumed	No. chicks started	No. chicks reared	Percent mortality	Average wt. per chick	Fuel consumed	No. chicks started	No. chicks reared	Percent mortality	Average wt. per chick	Fuel consumed
Commercial electric with fan	200	191	4.5	1.75	KWH 543	200	175	12.5	1.54	KWH 359					
Commercial electric with nat. ventilation	200	181	9.5	1.74	KWH 283	200	162	19.0*	1.42	KWH 251	150	140	6.6	1.61	KWH 132
Converted electric	200	170	15.0	1.77	KWH 533										
Home-made electric	200	177	11.5	1.15	KWH 405	200	186	7.0	1.42	KWH 387					
Wood						200	191	4.5	1.40	Cu. ft. 124	150	143	4.6	1.59	Cu. ft. 44
Coal	200	185	7.5	1.98	Lbs. 1895	200	193	3.5	1.55	Lbs. 1326	150	139	7.3	1.58	Lbs. 408
Kerosene	200	182	9.0	1.90	Gal. 251	200	184	8.0	1.42	Gal. 132	150	144	5.2	1.72	Gal. 66
*The metal screen was carelessly placed too far from the brooder on the first day of this brood, resulting in a large number of chicks getting too far															

*The metal screen was carelessly placed too far from the brooder on the first day of this brood, resulting in a large number of chicks getting too far from the brooder and freezing to death.

Table 9. The number of hours of labor required to operate the chick brooders during the three series of tests.

Brooder	Changing litter			Adjusting temperature regulator			Supplying fuel, cleaning and removing ashes			Total number of hours of labor		
	First test	Second test	Third test	First test	Second test	Third test	First test	Second test	Third test	First test	Second test	Third test
Commercial electric with fan	9	5		1½	1½		0	0		10½	6½	
Commercial electric with natural ventilation	7	5	4	1	1½	1	0	0	0	8	6½	5
Converted electric	7			2			0			9		
Home-made electric	9	5		1½	1½		0	0		10½	6½	
Coal	5	4	4	1	2	1	47½	28	19	53½	34	24
Kerosene	5			2	2	1½	25½	18	9½	52½	24	15
Wood		4	4		1	1		18*	6½		23	14½

*Does not include cutting or hauling the wood to the brooder house.

specially designed smoke stack which carries a bucket for catching pitch and other wood residues that are deposited in the pipe.

The stock for these tests consisted of 1,000 Barred Plymouth Rock and 200 Rhode Island Red chicks, all Virginia state certified and purchased from the hatchery. The chicks were divided so that an equal number of each breed was placed in each house, making a total of 200 chicks per house. The brooding was started on February 11, and records were kept for a period of eight weeks in the same manner as in the first series of tests. The average outside temperature during this brooding period was 44° F. The maximum temperature was 74° F. and the minimum was 7° F. There was precipitation on 45 percent of the days, and 61 percent of the days were cloudy.

THIRD SERIES

The following four types of brooders were used in this series of tests: (1) Natural ventilation commercial electric, (2) wood stove, (3) coal, and (4) kerosene. The electric brooder used in this test was selected from the four electric brooders that had been used in the other tests because it held the best all-round record of operation.

Conditions under which the tests were carried on were such that it was necessary to keep the chicks confined in the brooder house during the entire brooding period. In view of these conditions, the number of chicks allotted to each house was reduced to 150. The stock used for this test came from the same hatchery and consisted of an equal number of Virginia state certified Jersey Black Giant, Barred Plymouth Rock and Rhode Island Red chicks. The breeds were all divided equally among the houses in order to assure uniform stock for each house. The maximum outside temperature during this period was 92° F. and the minimum was 37° F. The brooding was started on April 28, and records were kept for a period of 8 weeks.

Table 10. A suggested form for calculating cost for operating brooders.

	Fuel cost			Labor cost at—per hr.			Total operating cost		
	First test	Second test	Third test	First test	Second test	Third test	First test	Second test	Third test
Commercial electric with fan									
Commercial electric with nat. ventilation									
Converted electric.....									
Home-made electric....									
Kerosene									
Wood									

Reference: Virginia Agricultural Experiment Station Bulletin 306, "Tests of Chick Brooders," pages 2, 3, 4, 5, 6, 7, 8, and 10, tables 1, 2, 3, 4, and 5, November 1936, Blacksburg, Virginia.

The Effect of Confinement Brooding on Growth of Chickens

Conducted by: Kentucky Agricultural Experiment Station.

Conducted at: Lexington, Kentucky.

Period: Ten weeks, beginning April 7, 1931.

Purpose: To study the comparative growth of incubator-hatched White

Leghorn chickens brooded and raised according to three methods.

Procedure and conditions: At the beginning of the experiment, April 7, 1931, 360 one-day-old White Leghorn chicks were divided into three lots and weighed individually. Lot 1, which was to represent normal farm-raised chickens, was raised in a colony brooder house with access to bluegrass range and direct sunlight. Lot 2 was kept during the first 3 weeks in the battery brooder* with lot 3 and then transferred to the colony brooder house with lot 1. Lot 3 was kept in the battery brooder during the first 22 weeks. The chicks of lot 3, when 10 weeks of age, were transferred to compartments 18 inches high, in the same brooder.

Table 11. Rations received by all lots.

	Parts
Wheat bran	25
Wheat middlings	25
Ground yellow corn	25
Meat scrap (50 percent protein)	12
Dried buttermilk	10
Salt ..	1
Steamed bonemeal	5

Enough of a commercial cod-liver oil concentrate (.125 percent of the mash) was added to protect adequately against rickets. This mash and a grain mixture consisting of equal parts of cracked yellow corn and wheat were before the chickens in hoppers at all times.

Table 12. Bi-weekly average weight of chicks alive on the final weight day (pounds).

Date	Weeks	Colony brooder raised		Battery brooder raised		Battery brooder raised	
		43	48	50	40	41	41
		Cockerels	Pullets	Cockerels	Pullets	Cockerels	Pullets
		Wt. lbs.	Wt. lbs.	Wt. lbs.	Wt. lbs.	Wt. lbs.	Wt. lbs.
April 7	0	.083	.085	.085	.085	.088	.085
April 21	2	.165	.158	.187	.176	.187	.178
May 5	4	.396	.370	.482	.431	.475	.429
May 19	6	.722	.632	.781	.685	.781	.680
June 2	8	1.022	.900	1.068	.940	1.022	.834
June 16	10	1.583	1.328	1.632	1.389	1.748	1.460

Reference: Kentucky Agricultural Experiment Station Bulletin 346, "The Effect of Confinement Brooding on Growth and Egg Production," pages 3, 4, and 5, table 2, January 1934, Lexington, Kentucky.

Electric Brooding Under Winter Conditions

Conducted by: Pennsylvania Agricultural Experiment Station.

Conducted at: State College, Pennsylvania

Period: February 1 to March 28, 1939, Single Comb White Leghorns.

December 5, 1940 to January 31, 1941, Barred Plymouth Rocks.

Purpose: To determine the optimum number of square inches of comfortable electric brooder area per chick, as measured by practical brooding results under winter conditions.

Procedure and conditions: All chicks were brooded for an 8-week period in 10 x 12 foot colony brooder houses, no sun porches or ranges were used.

*A five-deck battery brooder, the compartments 3 feet square and 9 to 10 inches high, situated in a basement where it received no direct sunlight.

In each of the experiments reported 1,766 chicks were brooded in 4 paired groups, brooder allowances per chick being 7, 11, 15, and 19 square inches for each pair of groups.

Penn State chick starter mash was fed alone for 3 weeks to the Single Comb White Leghorns, and 4 weeks to the Barred Plymouth Rocks, insoluble grit being sprinkled on the mash whenever feeders were filled. Thereafter starter mash and intermediate size grain, equal parts of wheat, and cracked yellow corn were fed free choice. Day-old unsexed chicks were used.

Table 13. Electric brooding under winter conditions—Pennsylvania, 1939, 1940, and 1941.

Group No.	Brooder space per chick	Number of chicks		Mor-tali-ty	Total* feed con-sumed	Average weight		Feed per [©] lb. wt. at 8 weeks	Energy consumed**		Number of litter changes
		Start-ed	Rear-ed			4	8		Total	Per chick reared	
						weeks	weeks				
Single Comb White Leghorn chicks											
	sq. in.			percent	lb.	lb.	lb.	lb.	KWH	KWH	
4	19	132	127	3.81	516	.57	1.21	4.29	472	3.72	1
8	19	132	121	8.45	517	.57	1.21	4.21	494	4.08	0
3	15	167	164	1.81	509	.53	1.15	4.43	510	3.11	3
7	15	167	163	2.41	507	.57	1.23	4.15	536	3.29	3
2	11	227	220	3.12	521	.56	1.24	4.20	516	2.35	4
6	11	227	222	2.22	496	.56	1.16	4.32	454	2.05	4
1	7	357	335	6.21	495	.55	1.23	4.03	505	1.51	6
5	7	357	331	7.46	492	.55	1.23	3.99	526	1.59	6
Barred Plymouth Rock chicks											
1	19	132	130	1.51	517	.65	1.48	3.54	777	5.98	2
9	19	132	124	6.07	522	.62	1.53	3.43	713	5.75	3
10	15	167	160	4.20	504	.59	1.40	3.61	784	3.90	4
12	15	167	163	2.40	512	.63	1.39	3.70	710	4.36	5
3	11	227	220	3.08	490	.59	1.42	3.60	655	2.98	6
11	11	227	216	4.84	484	.60	1.35	3.45	798	3.70	6
2	7	357	316	11.48 ¹	447	.57	1.27	3.55	670	2.12	9
4	7	357	314	12.04 ²	470	.58	1.30	3.59	699	2.23	9

*Per 100 chicks for 8 weeks.

**Energy consumed refers to the number of kilowatt hours (KWH) of electricity used to generate heat in the resistance soils of each electric brooder.

©Feed per pound weight at eight weeks calculated by dividing total feed consumed by total weight of chicks reared.

¹2.5 percent (9 chicks) killed by concrete counter-weight at brooder when rope broke.

²3.1 percent (11 chicks) found dead in "huddle-pile" outside brooder at early morning inspection when 5 days of age.

Reference: Pennsylvania Agricultural Experiment Station Bulletin 416, "Electric Brooding under Winter Conditions," pages 2, 3, 5, and 8, tables 1 and 5, State College, Pennsylvania, November 1941.

Feeding Broilers

Feeding is one of the most important considerations in the production of broilers. In feeding young chicks it is very necessary that they receive the right kind and amount of feed in order to make a profitable gain. To make profitable gain chicks require proteins, minerals, carbohydrates and vitamins in their rations. These nutrients should be in proper balance in order to get the growth desired.

Proteins are a very important nutrient in the broiler ration. This nutrient is used for maintenance and development of the chick's body. At least 20 percent of the body is made up of proteins. There are some protein feeds produced in Mississippi that might be used in a broiler ration. They are cottonseed meal, milk and shrimp meal. The question might be asked, can broiler producers depend on these sources of feed alone to supply the broiler with the needed amount of protein?

Another very important nutrient in the broiler ration is minerals. Minerals are used in the development of bones and determine to a large extent the type of broiler produced. Approximately 4 percent of the broiler's body is made up of minerals..

Carbohydrates are also important in the broiler ration, but under most conditions this nutrient is supplied in sufficient quantities.

Vitamins have a direct bearing on the development of the young chicks, especially vitamins A, D and G. A ration deficient in vitamin A causes stunted growth and often times a disease similar to roup. The absence of vitamin D prevents proper bone development causing leg weakness and sometimes rickets. The lack of vitamin G causes loss of weight and stunted growth and often times nutritional paralysis.

As previously stated, in the Jackson broiler producing area all chicks were fed commercial mixed feed. You will notice that this feed contained a wide variety of ingredients, not depending entirely on one source to supply the different nutrients. This fact should be taken into consideration in making a study of this information.

PROTEINS

What are proteins?

Proteins are nitrogen-bearing compounds composed of carbon, hydrogen oxygen, and sometimes sulphur, phosphorus and iron—a group of nutrients essential to animal life. Proteins vary widely in composition. There are many thousands of different proteins, all of which, however may very probably be broken down by chemical methods to amino acids (about twenty). Certain of these amino acids are referred to as essential, and unless protein contains these essential amino acids they are "incomplete" and will not serve the purpose of the bird completely. One reason why poultrymen should feed a variety of feeds is that a variety of proteins is necessary in order to insure a sufficient amount of essential amino acids.

How does the broiler use protein?

Before the broiler can use the crude protein in feeds the process of breaking these crude proteins down into amino acids must take place. The amino acids are absorbed by the villi of the small intestines, finally passing into the blood stream. They are then carried into the general circulation, and

from the blood stream into each of the various tissues of the body; muscles, organs, etc. absorb a certain amount of the amino acids for growth or the repair of the daily waste of protein matter. The absorbed protein or amino acid which has been transferred to the tissues of the body may be oxidized or burned to warm the animal or to produce energy to carry on the vital processes. The amino acids may be built up into body protein or if not needed for this purpose a portion of their carbon, hydrogen or oxygen may be converted into fat. However, nitrogen is excreted chiefly in the form of urea. The highest use of the proteins, however, is the formation of nitrogenous tissues, the muscles, nerves, skin and various organs of the body.

Suggestive Questions

1. What protein feeds are produced on the farms of Mississippi that are suitable to use in feeding broilers?
2. Will cottonseed meal supply the necessary protein in the broiler ration?
3. Does cottonseed meal have a harmful effect on broilers?
4. What source of protein should be used in feeding broilers?
5. What percentage of protein should a broiler ration contain?
6. As the chicks grow older is it possible to reduce the protein content of the feed by substituting a lower protein feed?

Protein Requirements for Chickens

Conducted by: New Hampshire Agricultural Experiment Station.

Conducted at: Durham, New Hampshire.

Period: 12 weeks, started April 4, 1935.

Purpose: To determine (1) optimum levels of protein intake for chickens during their various stages of growth, and production, (2) efficient sources of protein, and (3) the most efficient combinations of sources for the various growth periods studied.

Procedure and conditions: In Test 1, 12 groups of 20 New Hampshire chicks were started April 4, 1935, and raised in growing batteries up to 12 weeks of age. In Test 2, 12 groups of 60 New Hampshire chicks were started April 7, 1937. The groups were fed various protein-carrying rations as outlined below:

Table 14. Percentage content of protein, calcium, phosphorus, and ash in protein concentrates and basal ration.

Ingredients	Protein		Calcium	Phosphorus	Ash
	Test 1	Test 2	Test 2	Test 2	Test 2
Fish meal	57.23	62.00	7.89	4.08	23.05
Meat scraps	55.62	55.34	8.88	4.34	26.56
Dried skimmilk	33.58	38.09	1.58	1.03	7.93
Basal ration	13.09	12.56	1.54	.54	6.78

Groups 1, 2 and 3: basal ration plus meat scraps to make 15, 17, and 19 percent protein content, respectively.

Groups 4, 5, and 6: basal ration plus white fish meal, vacuum processed, to make 15, 17, and 19 percent protein content, respectively.

Groups 7, 8, and 9: basal ration plus dried skimmilk to make 15, 17, and 19 percent protein content, respectively.

Groups 10, 11, and 12: basal ration plus a combination of the three animal

protein sources in equal protein-carrying amounts to make 15, 17, and 19 percent protein content, respectively.

The basal ration was composed of 200 pounds yellow corn meal, 100 pounds wheat bran, 100 pounds white flour middlings, 100 pounds ground heavy oats, 25 pounds alfalfa leaf meal, 15 pounds oystershell flour, 5 pounds salt, and 3 pounds biologically tested sardine oil. All groups in both test 1 and 2 were fed this ration plus specified protein in an all-mash form throughout the experimental procedure.

In Test 1 all chicks used were individually wing-banded and weighed weekly throughout the experimental period of 70 weeks. In test 2 average group weights were recorded up to time of placement in laying cages. Individual bi-monthly weights were recorded from this period to the end of the test. Feed consumption records in test 1 were determined weekly by groups throughout the first 12 weeks of the experimental period. In test 2 feed consumption records were maintained throughout the experimental period on a group basis weekly.

Protein concentrates used: Meat scraps used in the two tests were made from butcher shop and packers' trimmings. The product at the time of purchase was not over ten days old, but complete history of its manufacture together with percentage amounts of its component parts could not be secured.

Dried skim milk was made by the roller process and was received within one week of the date of manufacture.

The fish meal used in the tests is commonly termed vacuum-processed white fish meal. It was made from fish that were caught one day and processed the following day. The product produced contained several varieties of fish but consisted largely of cod and haddock. The raw product was ground, cooked and pressed previous to being placed in the dehydrator. The product was dehydrated at a 26"-27" vacuum at an inside temperature of approximately 120 degrees Fahrenheit.

Table 15. Summary of weight records in pounds per bird by stated weekly periods for meat scrap groups.

Age	Group 1		Group 2		Group 3	
	Test 1	Test 2	Test 1	Test 2	Test 1	Test 2
1 day	.0916	.0885	.0946	.0923	.0940	.0923
4 weeks	.4617	.3911	.5324	.4538	.5770	.4788
8 weeks	1.392	1.161	1.437	1.270	1.546	1.354
12 weeks	2.448	2.200	2.600	2.416	2.758	2.348
Feed consumed per chick	10.713	8.355	11.124	9.001	9.335	9.574

Table 16. Summary of weight records in pounds per bird by stated weekly periods for fish meal groups.

Age	Group 4		Group 5		Group 6	
	Test 1	Test 2	Test 1	Test 2	Test 1	Test 2
1 day	.0936	.0923	.0920	.0923	.0946	.0884
4 weeks	.4934	.4745	.5320	.4961	.5900	.5287
8 weeks	1.364	1.480	1.560	1.484	1.647	1.592
12 weeks	2.429	2.721	2.797	2.750	2.780	2.798
Feed consumed per chick	10.379	9.822	11.201	8.969	10.474	9.694

Table 17. Summary of weight records in pounds per bird by stated weekly periods for dried skim milk groups.

Age	Group 7		Group 8		Group 9	
	Test 1	Test 2	Test 1	Test 2	Test 1	Test 2
1 day	.0933	.0884	.0923	.0923	.0910	.0923
4 weeks	.4748	.4325	.4966	.4570	.5392	.4637
8 weeks	1.308	1.125	1.403	1.000	1.511	1.153
12 weeks	2.293	2.167	2.645	2.222	2.805	1.913
Feed consumed per chick	9.917	7.755	10.238	8.401	11.544	7.345

Table 18. Summary of weight records in pounds per bird by stated weekly periods for protein mixture groups.

Age	Group 10		Group 11		Group 12	
	Test 1	Test 2	Test 1	Test 2	Test 1	Test 2
1 day	.0923	.0923	.0933	.0846	.0916	.0884
4 weeks	.4739	.4041	.5741	.4827	.6067	.5040
8 weeks	1.413	1.241	1.543	1.525	1.657	1.508
12 weeks	2.714	2.339	2.890	2.777	2.961	2.846
Feed consumed per chick	10.484	8.952	10.856	10.019	11.481	10.061

Reference: New Hampshire Agricultural Experiment Station Bulletin 312, "Protein Requirements of Chickens at Various Stages of Growth and Development," pages 3, 4, 5, 6, 7, 8, 9 and 10, tables 1, 3a, 3b, 3c, 3d, 4a, 4b, 4c, and 4d, May 1939, Durham, New Hampshire.

Protein Levels for Broiler Production

Conducted by: Delaware Agricultural Experiment Station.

Conducted at: Newark, Delaware.

Period: 11 weeks, December 1, 1937 through February 15, 1938.

Purpose: To determine protein levels for broiler production.

Procedure and conditions: The chicks used in the experiment were hatched on November 30, 1937 and placed in the brooder house December 1, 1937. Eight hundred and twenty-eight crossbred chicks, obtained by crossing Barred Plymouth Rock males and Rhode Island Red females were delivered by the hatchery on December 1. These chicks were then divided into four groups of 207 chicks and placed in the experimental pens.

The chicks were brooded in an open front, shed roof long brooder house in pens 10 by 14 feet. Each pen was provided with a 10 by 12 foot concrete sun porch. The brooder pen floors were of concrete and a sugarcane by-product and peanut hulls were used as litter. Shredded corn stover was spread over the concrete sun porch to encourage the broiler chicks to make use of the porch when weather permitted.

Each pen was provided with a coal burning brooder stove with a 56-inch hover. Water was provided in each pen by automatic fountains.

The broilers were group weighed bi-weekly until the end of the eleventh week when they were individually weighed. Individual weights were obtained at the end of the twelfth, thirteenth, and fourteenth weeks of those broilers remaining in the pens.

The feed was fed as all-mash rations and was kept before the broilers at all times. All feed was weighed as it was placed in the pens and any feed remaining in the hoppers when the broilers were weighed was weighed back. Chick size oystershell and granite grit were available to the broilers throughout the experiment.

Table 19. Formulas for rations and compositions.

Ingredients	Rations and lot number			
	1	2	3	4
	Percent	Percent	Percent	Percent
Ground yellow corn	43.1	40.1	37.3	34.4
Wheat bran	14.4	13.3	12.4	11.4
Flour wheat middlings	14.4	13.3	12.4	11.4
Ground oat groats	10.7	10.0	9.3	8.6
Meat scraps (55 percent)	6.5	10.0	13.8	17.2
Dried buttermilk	4.3	6.7	9.2	11.4
Alfalfa leaf meal	4.7	4.7	4.7	4.7
Steamed bonemeal	1.0	1.0	—	—
Salt	0.7	0.7	0.7	0.7
Cod-liver oil (Conc.)	0.2	0.2	0.2	0.2
Totals ..	100.0	100.0	100.0	100.0
Percent protein	16.3	18.3	20.4	22.3
Percent fiber	4.2	3.9	3.8	3.6
Percent ash	5.5	6.3	6.7	7.6

Table 20. Average weight of broilers bi-weekly for 11 weeks.

Weeks	16.3 Percent	18.3 Percent	20.4 Percent	22.3 Percent
	Pounds	Pounds	Pounds	Pounds
Initial ..	0.078	0.077	0.078	0.077
2 ..	0.198	0.221	0.250	0.249
4 ..	0.476	0.546	0.604	0.526
6 ..	0.904	0.995	1.110	1.042
8 ..	1.389	1.538	1.562	1.581
10 ..	1.856	2.063	2.095	2.117
11 ..	2.207	2.397	2.439	2.469

Pen number	1	2	3	4
Protein level, in percent	16.3	18.3	20.4	22.3
Original no. of chicks	207	207	207	207
Final no. of broilers	202	199	199	190
Average no. of broilers	205.3	200.1	201.6	198.0
Percent mortality	2.4	3.9	3.9	8.2
Number of days on feed	77	77	77	77
Initial av. weight, lbs.	0.078	0.077	0.078	0.077
Final av. weight, lbs.	2.207	2.397	2.439	2.469
Av. gain per broiler, lbs.	2.129	2.320	2.361	2.392
Feed consumed per pen, lbs.	1649.75	1682.75	1715.31	1675.00
Av. feed consumed per broiler, lbs.	8.06	8.42	8.51	8.46
Lbs. feed required per pound gain	3.78	3.63	3.60	3.69

Reference: Delaware Agricultural Experiment Station Bulletin 210, "Broiler Feeding Experiments," pages 5, 6, 7, and 10, tables 1, 2, and 4, June 1938, Newark, Delaware.

The Comparative Effect of Various Proteins for Growing Chicks

Conducted by: Washington Agricultural Experiment Station.

Conducted at: Pullman, Washington.

Period: 14 weeks, beginning April, 1933.

Purpose: To determine the comparative efficiency of Alaska herring fish meal, skimmilk powder, high grade meat scrap (56 percent protein), and Manchurian soybean meal for growing chicks.

Procedure and conditions: This experiment was started in April 1933, with 800 Single Comb White Leghorn, Pullorum-free chicks. They were carefully selected for uniformity of health, vigor and weight, and divided into eight lots of 100 chicks each.

The chicks were brooded in a brooder house 16 x 200 feet, divided into 8 10 x 11 foot pens. Each lot was supplied with 100 square feet of wire sun porch, and the sun porches were available for the use of the birds in these pens when the weather permitted. Each brooding compartment was equipped with a 200-chick electric brooder. The chicks were brooded on wire frames the first eight weeks. Wasteproof hoppers with wire grids were supplied in each pen.

The formulas of the rations will be found in the table that follows. Each of the four protein concentrates were fed at levels of approximately 13 to 16 percent protein. All rations were balanced at a level of approximately 1.6 percent calcium and 0.8 percent phosphorus. Sufficient vitamin D was supplied by the addition of one-fourth percent of concentrated cod-liver oil to the ration. These rations were fed as all-mash rations to the growing pullets from the age of two days to 14 weeks inclusive.

The chicks were individually weighed bi-weekly. All the cockerels were removed from each lot at eight weeks of age. All the data reported herein applied to pullets. A record was kept of their mortality and feed consumption.

Table 21. Rations—Pullman, Washington, 1933.

Lot number	1	2	3	4	5	6	7	8
Percent Protein	13	16	13	16	13	16	13	16
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Basal	85.54	81.02	78.52	65.75	85.34	80.48	81.70	72.66
Dehydrated alfalfa	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Salt	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Oystershell flour	1.85	1.98	1.73	1.73	1.70	1.55	1.75	1.75
Bonemeal	2.10	1.42	2.15	1.54	1.36	0.00	2.55	2.40
Cod-liver oil	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Herring fish meal	4.26	9.33	—	—	—	—	—	—
Skimmilk powder	—	—	11.35	24.73	—	—	—	—
Meat scrap	—	—	—	—	5.35	11.72	—	—
Manchurian soybean meal	—	—	—	—	—	—	7.75	16.94
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Reference: Washington Agricultural Experiment Station Bulletin 321, "The Comparative Efficiency of Various Proteins for Growing Chicks," pages 5, 7, 8, 9 and 10, tables 2 and 4, August 1935, Pullman, Washington.

The Comparative Effect of Various Proteins for Growing Chicks

Conducted by: Washington Agricultural Experiment Station.

Conducted at: Puyallup, Washington.

Period: 14 weeks.

Purpose: To compare various protein feeds for growing chicks.

Procedure and conditions: The experiment was started in April 1933 with 1200 Single Comb White Leghorn, Pullorum-free chicks. They were divided into eight lots of 150 chicks each, carefully selected for uniformity of health, vigor, and weight.

The chicks were brooded in a brooder house 20' x 120', divided into eight 15' x 20' pens. All lots of chicks were supplied with a sun porch which was available when the weather permitted. Similar equipment and methods of brooding were used as is described in the experiment run at Pullman, Washington.

The formulas for the rations will be found in the table that follows. Each lot was fed an all-mash ration with a protein level of approximately 16 per cent. The same levels of calcium, phosphorus, and vitamin D were used in these rations as were used in the Pullman experiment.

The chicks were individually weighed bi-weekly. All of the data reported herein applied to pullets, the cockerels being removed at six weeks of age.

Table 23. Formulas for rations—Puyallup, Washington.

Lot number	1	2	3	4	5	6	7	8
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Basal	81.20	77.33	74.49	80.98	77.85	75.98	79.18	77.69
Dehydrated alfalfa	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Salt	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Oystershell flour	2.08	2.00	2.00	1.93	2.00	2.00	2.00	2.00
Bonemeal	1.41	1.86	1.42	0.63	1.00	1.61	1.20	1.27
Cod-liver oil	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Herring fish meal	9.31	4.92	5.15	4.70	4.92	5.03	4.81	4.92
Skimmilk powder	—	—	10.94	—	5.22	5.34	—	3.48
Meat scrap	—	—	—	5.76	3.01	—	2.95	2.01
Manchurian soybean meal	—	7.89	—	—	—	4.04	3.86	2.63
Total	100.25	100.25	100.25	100.25	100.25	100.25	100.25	100.25

Reference: Washington Agricultural Experiment Station Bulletin 321, "The Comparative Efficiency of Various Proteins for Growing Chicks," pages 18, 19, and 22, August 1935, Pullman, Washington.

Table 24. Feed consumed and weight of pullets bi-weekly for 14 weeks.

Lot No.	1		2		3		4		5		6		7		8	
Protein Level in Percent	16		16		16		16		16		16		16		16	
Kind of protein	Alaska herring fish meal		Alaska herring fish meal & soybean meal		Herring meal and skim-milk		Herring meal and meat scrap		Herring meal skimmilk powder and meat scrap		Herring meal skimmilk powder and soybean meal		Herring meal meat scrap & soybean meal		Herring meal skimmilk, meat scrap, soy-bean meal ¹	
Weeks	Wt. of feed lbs.	Wt. of chick lbs.	Wt. of feed lbs.	Wt. of chick lbs.	Wt. of feed lbs.	Wt. of chick lbs.	Wt. of feed lbs.	Wt. of chick lbs.	Wt. of feed lbs.	Wt. of chick lbs.	Wt. of feed lbs.	Wt. of chick lbs.	Wt. of feed lbs.	Wt. of chick lbs.	Wt. of feed lbs.	Wt. of chick lbs.
0	—	0.08	—	0.08	—	0.08	—	0.08	—	0.08	—	0.08	—	0.08	—	0.08
2	0.59	0.18	0.53	0.18	0.57	0.19	0.52	0.18	0.55	0.19	0.55	0.19	0.52	0.16	0.53	0.18
4	0.70	0.38	0.77	0.36	0.89	0.43	0.74	0.37	0.79	0.39	0.84	0.42	0.76	0.35	0.87	0.43
6	1.77	0.71	1.32	0.67	1.36	0.80	1.15	0.70	1.24	0.76	1.24	0.80	1.19	0.67	1.38	0.80
8	1.54	1.04	1.48	0.8	1.64	1.14	1.56	1.04	1.55	1.12	1.55	1.16	1.51	0.98	1.66	1.15
10	1.62	1.41	1.56	1.1	1.77	1.54	1.68	1.41	1.73	1.50	1.68	1.51	1.61	1.32	1.75	1.52
12	1.89	1.81	1.88	1.1	1.93	1.92	1.87	1.82	1.92	1.91	1.89	1.89	1.86	1.71	1.90	1.93
14	2.07	2.17	2.05	2.10	2.16	2.36	2.12	2.20	2.13	2.27	2.15	2.25	2.09	2.09	2.18	2.26

Cottonseed Meal in Chick Rations

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Clemson, South Carolina.

Period: 1937.

Purpose: To determine the use and value of cottonseed meal in starting and growing rations for chickens.

Procedure and conditions: This test consisted of two experiments each run in duplicate.

First experiment. In this experiment cottonseed meal was used to replace one-fourth, one-half, and three-fourths, respectively, of the meat scrap protein in the chick ration. Ample quantities of dried whey and alfalfa leaf meal were included to provide sufficient vitamin G. Vitamin D was supplied by a cod-liver concentrate. Calcium carbonate was added to supply the deficiency of cottonseed meal in this element. A chick starting ration containing dried milk and alfalfa leaf meal as commonly recommended by the station was included in the trials as a further check on the results obtained. All rations contained approximately 18 percent protein.

Twenty-five day-old Single Comb White Leghorn chicks were used in each pen. The chicks were brooded in individually heated battery brooders for the first four weeks, then transferred to wire-floored pens in a heated room for the remainder of the eight week period. The ration was fed as an all-mash, which along with water, was kept before the birds at all times.

Second experiment. The second experiment was conducted to determine the amount of vitamin G carriers required to supplement the chick starting ration when cottonseed meal is used to replace one-half of the protein from meat scraps. The same type of chicks brooded under similar conditions was

Table 25. Rations, growth, and mortality of chicks when cottonseed meal replaced varying proportions of meat scraps.

EXPERIMENT I

Ingredients	Pen number				
	1	2	3	4	5
Pounds of ingredients in 100 pounds ration					
Yellow corn meal	49.77	42.01	41.13	38.89	36.65
Wheat middlings	25.00	25.00	25.00	25.00	25.00
Meat scrap, 50 percent protein	18.48	19.74	14.81	10.04	5.08
Cottonseed meal, 41 percent protein	—	—	5.81	11.82	18.02
Dried skim milk	3.00	—	—	—	—
Dried whey	—	7.50	7.50	7.50	7.50
Alfalfa leaf meal, dehydrated	3.00	5.00	5.00	5.00	5.00
Steamed bonemeal	—	—	—	1.00	2.00
Salt	0.50	0.50	0.50	0.50	0.50
Cod-liver oil, concentrate	0.25	0.25	0.25	0.25	0.25
Summary of results after eight weeks					
Average weight per chick, pounds:					
Trial 1	1.2	1.2	1.4	1.3	1.3
Trial 2	1.3	1.2	1.4	1.3	1.2
Lbs. feed required per pound gain:					
Trial 1	3.52	3.80	3.48	3.68	3.84
Trial 2	3.50	3.71	3.47	3.81	4.12
Mortality, number:					
Trial 1	1	2	0	0	0
Trial 2	1	0	0	0	2

EXPERIMENT II

Ingredient	Pen number						
	1	2	3	4	5	6	7
Pounds of ingredients in 100 pounds ration							
Yellow corn meal.....	45.38	50.22	46.60	44.60	42.60	41.07	39.07
Wheat middlings	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Meat scrap, 50% protein.....	13.87	10.72	10.08	10.08	10.08	9.86	9.86
Cottonseed meal, 41% protein	—	12.31	11.57	11.57	11.57	11.32	11.32
Dried skimmilk	100.00	—	—	—	—	—	—
Dried whey	—	—	—	2.00	4.00	6.00	8.00
Alfalfa leaf meal, dehydrated....	5.00	—	5.00	5.00	5.00	5.00	5.00
Oystershell meal	—	1.00	1.00	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Cod-liver oil, concentrate.....	0.25	0.25	0.25	0.25	0.25	0.25	0.25

Summary of results after eight weeks

Av. weight per chick, pounds:							
Trial 1	1.5	1.1	1.3	1.3	1.4	1.4	1.3
Trial 2	1.4	0.9	1.1	1.2	1.3	1.3	1.3
Lbs. feed required per pound gain:							
Trial 1	3.15	3.61	3.42	3.48	3.37	3.44	3.79
Trial 2	3.57	4.37	3.88	3.68	3.73	3.79	4.07
Mortality, number:							
Trial 1	0	0	1	1	0	1	0
Trial 2	0	0	0	0	0	0	0

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used in this experiment except only 20 chicks per pen were used in the first trial. Variations in the vitamin G content of the ration were made through the use of different amounts of dried whey. A standard starting ration containing 10 percent dried milk and 5 percent alfalfa leaf meal was used for comparison.

Reference: Agricultural Education Vol. 15, No. 4, pages 51, 52, 53, tables 2 and 3, December 1938, Clemson, S. C.

Cottonseed Meal Compared with Shrimp Meal as Source of Protein

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: Spring and summer, 1938.

Purpose: To compare cottonseed meal with shrimp meal as a source of protein.

Procedure and conditions: Two tests were conducted for a period of eight weeks, one being replica. The first test began April 18, 1938, the second June 15, 1938. The tests were conducted in battery brooders, with thirty chicks to the lot. In each test, lot 1 was fed State College Starting Mash, lot 2 the same except 13 pounds of shrimp meal was replaced with cottonseed meal.

Reference: Unpublished information of Poultry Department, Mississippi Agricultural Experiment Station, State College, Mississippi.

Rations for Lot 1		Rations for Lot 2	
40 lbs. corn meal (white)		40 lbs. corn meal (white)	
7 lbs. wheat shorts		7 lbs. wheat shorts	
10 lbs. wheat bran		10 lbs. wheat bran	
13 lbs. shrimp meal		13 lbs. cottonseed meal	
5 lbs. alfalfa leaf meal		5 lbs. alfalfa leafmeal	
10 lbs. ground oats		10 lbs. ground oats	
5 lbs. dried milk		5 lbs. dried milk	
½ lbs. cod-liver oil		½ lb. cod-liver oil	
½ lb. salt		½ lb. salt	
Oystershell flour ad libitum		Oystershell flour ad libitum	

Table 26. Average weights and feed consumption by weeks—first test of chicks completing test. Lot 1, 26 chicks; Lot 2, 23 chicks.

Weeks	Start	1	2	3	4	5	6	7	8	
Lot 1, weight in ounces	1.44	2.73	3.93	5.24	8.08	11.34	15.38	18.80	21.80	
Lot 2, weight in ounces	1.44	2.39	3.71	4.80	7.37	8.50	12.82	14.65	18.00	
Lot 1, feed in lbs. per chick	—	.125	.250	.346	.385	.544	.799	.862	.951	Total feed 4.262

Table 27. Average weights and feed consumption by weeks—second test of chicks completing test. Lot 1, 24 chicks; Lot 2, 24 chicks.

Weeks	Start	1	2	3	4	5	6	7	8	
Lot 1, weight in ounces	1.50	1.99	2.99	3.95	6.18	9.32	12.94	14.44	18.90	
Lot 2, weight in ounces	2.07	2.19	2.66	2.50	6.75	6.48	9.12	10.27	12.70	
Lot 1, feed in lbs. per chick	—	.094	.156	.276	.290	.500	.590	.885	.880	Total feed 3.671
Lot 2, feed in lbs. per chick	—	.140	.150	.250	.302	.380	.550	.600	.630	Total feed 3.002

Table 28. Average weight and feed consumption by weeks—Tests 1 and 2 combined.

Weeks	Start	1	2	3	4	5	6	7	8	
Lot 1, weight in ounces	1.46	2.37	3.48	4.62	7.168	10.47	14.20	16.71	20.39	
Lot 2, weight in ounces	1.76	2.29	3.17	3.62	7.05	7.47	10.93	12.41	14.80	
Lot 1, feed in lbs. per chick	—	.11	.205	.312	.337	.537	.700	.870	.917	Total feed 3.988
Lot 2, feed in lbs. per chick	—	.160	.190	.290	.340	.480	.610	.730	.730	Total feed 3.530

Cottonseed Meal, Shrimp Meal and Meat Scrap as Protein Supplements for Growing Chicks in Mississippi

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 8 weeks.

Purpose: To compare cottonseed meal, shrimp meal and meat scrap as protein supplements for growing chicks.

Procedure and conditions: There were 28, 5-day-old chicks in each of the three groups in the test.

During the first 6 weeks of the test the chicks were fed the following rations:

Cottonseed meal ration			Shrimp meal ration			Meat scrap ration		
34½ lbs.	yellow corn meal		37½ lbs.	yellow corn meal		37½ lbs.	yellow corn meal	
10 lbs.	wheat shorts		10 lbs.	wheat shorts		10 lbs.	wheat shorts	
10 lbs.	wheat bran		10 lbs.	wheat bran		10 lbs.	wheat bran	
5 lbs.	alfalfa meal		10 lbs.	ground oats		10 lbs.	ground oats	
10 lbs.	ground oats		5 lbs.	alfalfa leaf meal		5 lbs.	alfalfa leaf meal	
7½ lbs.	dried milk		7½ lbs.	dried milk		7½ lbs.	dried milk	
22 lbs.	cottonseed meal		5 lbs.	cottonseed meal		13 lbs.	meat scraps	
2½ lbs.	oystershell flour		1 lb.	bonemeal		5 lbs.	cottonseed meal	
1 lb.	bonemeal		13 lbs.	shrimp meal		½ lb.	salt	
½ lb.	salt		½ lb.	salt		½ lb.	cod-liver oil	
½ lb.	cod-liver oil		½ lb.	cod-liver oil				

At the age of 6 weeks the rations were changed to the following growing mash:

Cottonseed meal ration			Shrimp meal ration			Meat scrap ration		
55½ lbs.	yellow corn meal		58 lbs.	yellow corn meal		58 lbs.	yellow corn meal	
7 lbs.	wheat shorts		7 lb.	wheat shorts		7 lbs.	wheat shorts	
7 lbs.	wheat bran		7 lbs.	wheat bran		7 lbs.	wheat bran	
14½ lbs.	cottonseed meal		8½ lbs.	shrimp meal		8½ lbs.	meat scrap	
4½ lbs.	alfalfa leaf meal		4½ lbs.	alfalfa leaf meal		4½ lbs.	alfalfa leaf meal	
6½ lbs.	ground oats		6½ lbs.	ground oats		6½ lbs.	ground oats	
5 lbs.	dried milk		3½ lbs.	cottonseed meal		3½ lbs.	cottonseed meal	
3 lbs.	oystershell flour		5 lbs.	dried milk		5 lbs.	dried milk	
½ lb.	bonemeal		1 lb.	oystershell flour		1/3 lb.	oystershell flour	
½ lb.	salt		½ lb.	salt		½ lb.	salt	
½ lb.	cod-liver oil		½ lb.	cod-liver oil		½ lb.	cod-liver oil	

In the cottonseed meal group 3 chicks died of nutritional paralysis.

Two chicks died in the meat scrap group during the test.

The group receiving the shrimp meal had one chick to die and one chick was killed.

Table 29. Cottonseed meal, shrimp meal, and meat scrap as protein supplement.

Ration	Initial weight	Weight of chick (ounces)								Total
		Weight 1st wk.	Weight 2nd wk.	Weight 3rd wk.	Weight 4th wk.	Weight 5th wk.	Weight 6th wk.	Weight 7th wk.	Weight 8th wk.	
Cottonseed meal	2.5	3.134	4.718	5.415	10.17	13.08	15.04	17.86	20.8	
Shrimp meal	2.41	3.13	4.83	6.91	10.09	14.16	18.92	23.02	28.13	
Meat scrap	2.5	2.8	3.9	5.4	8.6	12.27	16.9	20.86	26.82	
Feed consumed by weeks and total (pounds) for 28 chicks										
Cottonseed meal	—	4.5	7.0	10.6	14.4	19.85	21.07	24.0	21.5	122.92
Shrimp meal	—	3.75	8.85	11.85	16.6	19.85	26.13	29.2	31.0	147.23
Meat scrap	—	3.5	6.07	8.07	14.4	17.75	22.75	26.7	28.2	127.44

Reference: Unpublished information from the Poultry Department, Mississippi Agricultural Experiment Station, State College, Mississippi.

Cottonseed Meal, Shrimp Meal, and Meat Scrap as Protein Supplement for Producing Broilers

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 8 weeks, beginning April 4, 1939.

Purpose: To compare cottonseed meal, shrimp meal and meat scrap as protein supplement for producing broilers.

Procedure and conditions: Three pens of 30 chickens each were selected for this test. The rations were calculated as near as possible on the same weight basis and in all cases at the end of the 6th week the dried milk was cut to five pounds, and other protein reduced equally to lower level.

The following rations were fed each pen:

Cottonseed meal ration		Shrimp meal ration		Meat scrap ration	
34½ lbs.	yellow corn meal	38½ lbs.	yellow corn meal	39½ lbs.	yellow corn meal
10 lbs.	wheat shorts	10 lbs.	wheat shorts	10 lbs.	wheat shorts
10 lbs.	wheat bran	10 lbs.	wheat bran	10 lbs.	wheat bran
5 lbs.	alfalfa meal	10 lbs.	ground oats	10 lbs.	ground oats
10 lbs.	ground oats	5 lbs.	alfalfa leaf meal	5 lbs.	alfalfa leaf meal
7½ lbs.	dried milk	7½ lbs.	dried milk	7½ lbs.	dried milk
22 lbs.	cottonseed meal	17 lbs.	shrimp meal	17 lbs.	meat scrap
2½ lbs.	oystershell flour	½ lb.	salt	½ lb.	salt
1 lb.	bonemeal	½ lb.	cod-liver oil	½ lb.	cod-liver oil
½ lb.	salt				

In the cottonseed meal group two chicks developed nutritional paralysis.

In the meat scrap group 11 chickens developed slipped tendons with 17 percent level of meat scrap which points out that the mineral matter was unbalanced or excessive.

Table 30. Cottonseed meal, shrimp meal, and meat scrap as protein supplement.

Ration	Initial weight	Weight 1st wk.	Weight 2nd wk.	Weight 3rd wk.	Weight 4th wk.	Weight 5th wk.	Weight 6th wk.	Weight 7th wk.	Weight 8th wk.	Total
	Weight of chicks (ounces)									
Cottonseed meal.....	1.61	2.16	3.52	5.64	8.20	11.56	15.96	20.67	25.93	
Shrimp meal.....	1.58	2.12	3.62	5.74	8.85	12.16	17.46	21.91	26.66	
Meat scrap.....	1.49	2.23	3.38	5.09	7.72	11.12	14.67	18.09	21.2	
	Feed consumed by weeks and total (pounds) for 30 chicks									
Cottonseed meal.....	—	3.1	6.3	10.4	13.3	18.5	19.6	28.0	27.6	126.33
Shrimp meal.....	—	3.5	5.6	9.3	13.4	19.5	21.0	28.9	29.6	130.17
Meat scrap.....	—	2.2	5.5	8.7	13.4	17.1	19.2	25.3	22.3	113.65

Reference: Unpublished information of the Poultry Department, Mississippi Agricultural Experiment Station, State College, Mississippi.

A Comparison of the Nutritive Values of Cottonseed Meal, Alfalfa Leaf Meal and Meat and Bone Scraps in a Ration for Growing Chicks

Conducted by: New Mexico Agricultural Experiment Station.

Conducted at: State College, New Mexico.

Period: 3 years, 1930, 1931 and 1932.

Purpose: To study the comparative value of the three feeds: cottonseed meal, alfalfa leaf meal and meat and bone scraps.

Procedure and conditions: The chicks used in this test were Single Comb White Leghorns hatched from the Experiment Station's breeding flocks. They were brooded in colony type brooder houses around colony house style brooder stoves. The chicks were weighed on the second day after hatching, before being placed in the brooder, again on the seventh day, and at weekly intervals thereafter until they were 8 weeks old. From 8 weeks on, only the pullets were kept in the experiment and they were weighed every four weeks until they were 24 weeks old.

The chicks were kept on the starting rations until they were 8 weeks old, at which time they were changed to the growing rations, which ration for each pen was of the same nature as the starting ration for that particular pen. At 24 weeks of age the pullets were all housed in the same laying house and all given the standard laying ration used at this Station. Their trap nest records were kept during their first laying year, in order to learn whether or not the starting and growing ration given each pen exerted any influence on the pullet's production.

The method followed in preparing the different rations and in conducting the test was one developed by the Bureau of Animal Industry of the United States Department of Agriculture in connection with several of the Southwestern agricultural experiment stations. This method of procedure, called the "Uniform Method," is planned to provide a basal ration which is complete in all essential nutrients and in which substitutions of the feed being studied may be made without effecting the results obtained in any way, other than the difference produced by the feed which is being tested. To accomplish this, the basal ration is well supplied with the various food nutrients, vitamins, and minerals, from a variety of sources. Substitutions of the feeds being studied are made in the basal ration without materially changing the value of the ration in any other way. For example, the variety of feeds in the ration is not changed by the substitution. The vitamin and mineral requirements are still adequately provided for, the difference in the total amount of protein, carbohydrates, or fats supplied is slight. In order that the results obtained may be more easily compared, the method recommends that all pens be fed the same amount. To accomplish this, it was necessary to feed the chicks a limited amount of feed each day instead of supplying it to them ad libitum. In this test the pens were fed approximately 85 percent of the amount which they would normally have consumed if fed ad libitum.

During the brooding season of 1930 a number of chicks developed a peculiar form of leg weakness. This type of leg weakness is, apparently, caused by lack of balance among the nutrients and minerals in the ration. The ration seemed to contain more phosphorus in proportion to calcium than it should, giving it a calcium-phosphorus ratio which was too narrow. A wider cal-

cium-phosphorus ratio was obtained by replacing the steamed bonemeal with 2 pounds of fine oystershell.

Table 31 gives the starting mash given each pen in 1931 and 1932. These rations have been slightly changed since 1930.

Table 31. Formulas for the starting mash given each pen in 1931 and 1932.

Feeds	Pen 1 basal ration	Pen 2	Pen 3	Pen 4	Pen 5
	Pounds	Pounds	Pounds	Pounds	Pounds
Yellow corn meal.....	40.0	40.0	40.0	40.0	40.0
Wheat bran	13.0	13.0	13.0	13.0	13.0
Rice bran	10.0	10.0	10.0	10.0	10.0
Corn gluten meal.....	10.0	—	10.0	—	10.0
Dried buttermilk	10.0	10.0	10.0	10.0	10.0
Meat and bone scraps.....	10.0	10.0	—	10.0	—
Cottonseed meal	—	10.0	10.0	—	—
Alfalfa leaf meal	—	—	—	10.0	10.0
Fine oystershell	4.2	4.2	4.2	4.2	4.2
Cod-liver oil	2.0	2.0	2.0	2.0	2.0
Salt	0.8	0.8	0.8	0.8	0.8

At 8 weeks of age the cockerels were removed from the flock, leaving the pullets to continue in the experiment. At this time they were changed to growing rations, the formulas for which are given in the table below.

Table 32. Growing mash rations fed each group from 8 weeks to 24 weeks of age.

Feeds	Pen 1 basal ration	Pen 2	Pen 3	Pen 4	Pen 5
	Pounds	Pounds	Pounds	Pounds	Pounds
Mash					
Yellow corn meal.....	40.0	40.0	40.0	40.0	40.0
Ground wheat	25.0	25.0	25.0	25.0	25.0
Corn gluten meal	10.0	—	10.0	—	10.0
Cottonseed meal	—	10.0	10.0	—	—
Dried buttermilk	10.0	10.0	10.0	10.0	10.0
Meat and bone scraps.....	10.0	10.0	—	10.0	—
Alfalfa leaf meal	2.5	2.5	2.5	12.5	12.5
Fine oystershell	2.5	2.5	2.5	2.5	2.5
Total weight of mash.....	100.0	100.0	100.0	100.0	100.0
Scratch					
Wheat	50.0	50.0	50.0	50.0	50.0
Cracked yellow corn	25.0	25.0	25.0	25.0	25.0
Kafir	25.0	25.0	25.0	25.0	25.0
Total weight of scratch.....	100.0	100.0	100.0	100.0	100.0

From the time the pullets were 8 weeks old they were given their feed ad libitum. Both scratch grain and mash were kept in hoppers before pullets at all times.

Table 33. Average liveweight of the chicks in each group, average feed consumption, and the feed required to produce a gain of 1 pound.

	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5
Number chicks in group.....	240	240	240	240	240
Number chicks survived	215	208	203	206	200
Age of chicks (weeks)	8	8	8	8	8
Average liveweight (lbs.).....	.917	.945	.825	.843	.740
Average feed consumption (lbs.)	2.53	2.53	2.53	2.53	2.53
Lbs. feed required to produce 1 lb. of gain	3.03	3.01	3.40	3.33	3.85

Table 34. Average of 3 years' data on the pullets of each group, showing average weight, feed required to produce 1 pound of gain, and annual egg production.

	Pen 1	Pen 2	Pen 3	Pen 4	Pen 5
Age (weeks)	24	24	24	24	24
Number pullets	121	108	109	87	66
Average liveweight (lbs.)	2.99	3.07	3.00	2.86	2.61
Total feed to date (lbs.)	19.11	19.14	18.75	18.70	18.68
Feed required for a pound of gain	6.39	6.23	6.25	6.54	7.16
Average age when first egg was laid (days)	202	203	214	219	226
Annual egg production	153.2	148.3	141.0	157.3	145.8

Reference: New Mexico Agricultural Experiment Station Bulletin 221, "A Comparison of the Nutritive Values of Cottonseed Meal, Alfalfa Leaf Meal, and Meat and Bone Scraps in a Ration for Growing Chicks," pages 4, 5, 7, 8, 12, 13, 14, and 15, tables 3, 7, 8, and 9, March 1934, State College, New Mexico.

Dry Skimmilk in Poultry Rations

Conducted by: Pennsylvania Agricultural Experiment Station.

Conducted at: State College, Pennsylvania

Period: 3 years, 1935-1937.

Purpose: To study the effects of dry skimmilk in combination with meat and fish protein concentrates in the rations for growing chicks.

Procedure and conditions: Chicks from the Pennsylvania State College breeding flock were used in the first and third years. Progeny of the pullets used in the first year's experiment were used for the second year's experiment. Hatching dates for the 3 year's were: May 13, 1935; May 27, 1936, and May 25, 1937.

All chicks were weighed at hatching time and at bi-weekly intervals.

The formula of rations fed is given in table 35.

Table 35. Percent dry skimmilk used in ration—Pennsylvania, 1935-37.

Ingredient	Percent dry skimmilk							
	None	1.25	2.5	3.75	5.0	6.25	7.5	8.75
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Standard wheat middlings	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Wheat bran	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Ground heavy oats	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Alfalfa leaf meal	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Salt	.50	.50	.50	.50	.50	.50	.50	.50
Cod-liver oil	.50	.50	.50	.50	.50	.50	.50	.50
Ground yellow corn	50.00	49.30	48.59	47.90	47.20	46.50	46.80	45.09
Meat scraps	6.50	6.13	5.77	5.40	5.03	4.66	4.29	3.93
Fish meal	6.50	6.13	5.77	5.40	5.03	4.66	4.29	3.93
Ground limestone	1.00	1.01	1.02	1.03	1.04	1.05	1.07	1.08
Steamed bonemeal	—	.18	.35	.52	.70	.88	1.05	1.22
Dry skimmilk	—	1.25	2.50	3.75	5.00	6.25	7.50	8.75
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Mean chemical analyses: protein, 16.9 percent; calcium, 1.7 percent; phosphorus, 1 percent.

Table 36. Dry skim milk in poultry rations.

	Percent dry skim milk							
	None	1.25	2.5	3.75	5.0	6.25	7.5	8.75
Body weight								
Day old	.08	.08	.08	.08	.08	.08	.08	.08
2 weeks	.21	.21	.22	.22	.22	.22	.22	.21
4 weeks	.42	.43	.44	.46	.46	.49	.44	.46
6 weeks	.77	.76	.79	.80	.80	.83	.79	.83
8 weeks	1.08	1.12	1.16	1.14	1.15	1.21	1.14	1.22
10 weeks	1.44	1.48	1.53	1.51	1.53	1.59	1.50	1.55
12 weeks	1.80	1.83	1.89	1.88	1.90	1.97	1.85	1.95
Feed consumed								
Day old to 2 weeks	.42	.42	.42	.43	.43	.43	.43	.44
2 to 4 weeks	.74	.77	.76	.84	.79	.77	.79	.84
4 to 6 weeks	1.10	1.16	1.23	1.18	1.15	1.21	1.17	1.23
6 to 8 weeks	1.42	1.41	1.49	1.43	1.48	1.49	1.46	1.56
8 to 10 weeks	1.78	1.77	1.83	1.69	1.73	1.78	1.71	1.70
10 to 12 weeks	1.89	1.79	1.84	1.86	1.81	1.98	1.85	1.89

Reference: Pennsylvania Agricultural Experiment Station Bulletin 381, "Dry Skim milk in Rations for Growing, Laying and Breeding Fowls," State College, Pennsylvania, May 1939.

The Effect of Varying Amounts of Meat Scrap and Dried Milk for Starting Chicks

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: 8 to 10 weeks.

Purpose: To determine the proper amounts of meat and bone scrap and dried milk to feed chicks.

Procedure and conditions: Six trials, each involving two lots of chicks were conducted for a period of 8 or 10 weeks. Single Comb White Leghorn chicks were used in Experiment 1, while Barred Plymouth Rocks were used in the other trials. In each experiment the chicks were divided into similar lots according to weight and were placed in the pen when 24 to 48 hours old.

The chicks were brooded in confinement in the Nutritional Laboratories, either on brooder tables or in battery brooders. Both the brooder tables and battery brooders were equipped with wire floors. Heat was provided by small electric hovers on the brooder tables, one hover furnishing heat for the four pens on the table, and by electric heating units in the battery brooders. There was also supplemental heat in the room. The temperature under the hovers was kept at 95° to 100° F. at the start and was reduced gradually. An attempt was made to keep the room temperature at about 70° but it varied considerably, getting as low as 50° on some nights in winter and as high as 100° F. on some days in summer.

From 20 to 25 chicks were brooded in each pen on the tables. These pens will accommodate this number of chicks until they are eight weeks of age. Approximately 50 chicks were started in a compartment of the heated battery brooders. At four weeks of age each lot of 50 chicks was divided into two lots, one of which remained in the starting battery, while the other was transferred to a compartment of the same size in other batteries which were not heated. At this time heat was discontinued in the starting batteries.

Table 37. Rations.

	Experiments 1 & 2		Experiment 3		Experiment 4		Experiment 5		Experiment 6	
	Lots 1 and 2	Lots 3 and 4	Lot 5	Lot 6	Lot 7	Lot 8	Lot 9	Lot 10	Lot 11	Lot 12
Meat and bone scraps*	11.7**	14.6**	12.4*	15.5**	12	15	12	15	12	15
Dried buttermilk	4	6								
Dried skimmilk			4	6	4	6	4	5	4	5
Ground yellow corn	47.3	43.4	47.6	42.5	51	46	49.75	45.75	54	50
Wheat bran	15	15	15	15	15	15	15	15	15	15
Wheat middlings	15	15	15	15	15	15	15	15	15	15
Alfalfa leaf meal	3	3	3	3			3	3		
Steamed bonemeal	1 ***									
Salt	1	1	1	1	1	1	1	1		
Cod-liver oil stearin	2	2	2	2	2	2				
Concentrated cod-liver oil							0.25	0.25		
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Analyses; Meat and bone scraps; Experiments 1 and 2, 51.2 percent protein; Experiments 3 and 5, 48.5 percent.

**To supply protein equivalent to 12 percent (Lots 1, 3, and 5) and to 15 percent (Lots 2, 4, and 6) of 50 percent protein meat and bone scraps.

***P₂O₅ in 1 percent steamed bonemeal and 11.7 percent meat and bone scraps (Lots 1 and 3) equal to that supplied by 14.6 percent meat and bone scraps (Lots 2 and 4).

Two 10 x 12 foot colony brooder houses were used in each of Experiments 4 and 6. These houses were equipped with hard coal brooder stoves and standard feeding and watering equipment. Ground corn cobs were used for litter and the houses were cleaned once each week. In Experiment 4 the chicks were brooded in confinement, while in Experiment 6 they had access to range in small yards after the first two weeks.

In all of the experiments the ingredients of each ration were thoroughly mixed and fed as a dry mash kept before the chicks at all times. Water was given ad libitum.

The feed for each lot was kept in a separate container, numbered to correspond to the lot to which it was to be fed.

The rations fed in the different experiments are given in table 37.

Table 38. Average weights of males and females that lived throughout the experiment, and feed consumed per pound gain.

Experiment	Lot	Additions to basal ration	Number chicks		Eight weeks		Feed consumed per lb. gain start to 8 wks.
			Started	Finished	Males	Females	
1	1	11.7 meat & bone scraps					
		4 dried buttermilk.....	40	20	18	1.27	1.06
		14.6 meat & bone scraps					4.12
2	2	6 dried buttermilk.....	40	17	22	1.35	1.19
							3.73
3	3	11.7 meat & bone scraps					
		4 dried buttermilk.....	43	27	14	1.10	1.10
		14.6 meat & bone scraps					3.27
4	4	6 dried buttermilk.....	43	19	24	1.38	1.23
							2.96
5	5	12.4 meat & bone scraps					
		4 dried skimmilk.....	100	44	54	1.37	1.26
		15.5 meat & bone scraps					3.00
6	6	6 dried skimmilk.....	100	56	52	1.63	1.45
							2.88
7	7	12 meat & bone scraps					
		4 dried skimmilk.....	213	94	108	1.09	1.00
		15 meat & bone scraps					3.65
8	8	6 dried skimmilk.....	213	99	95	1.39	1.22
							3.29
9	9	12 meat & bone scraps					
		4 dried skimmilk.....	97	44	46	1.31	1.18
		15 meat & bone scraps					2.91
10	10	5 dried skimmilk.....	97	47	43	1.40	1.28
							2.75
11	11	12 meat & bone scraps					
		4 dried skimmilk.....	158	76	69	1.24	1.06
		15 meat & bone scraps					3.15
12	12	5 dried skimmilk.....	265	112	113	1.33	1.19
							2.93

Reference: Indiana Agricultural Experiment Station Bulletin 421, "Meat Scraps and Dried Milk in Rations for Starting Chicks," pages 3, 4, 7, 8, and 10, tables 1, 2, and 4, April 1937, Lafayette, Indiana.

The Value of Peanuts in Chick Rations

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: Three 8-week trials. The first started April 8, 1935, the second November 23, 1935 and the third March 9, 1936.

Purpose: To determine the value of peanuts in rations for chicks.

Procedure and conditions: One thousand five hundred Single Comb White Leghorn chicks were used in each of the trials.

The formulas used in this test contained approximately 18 percent crude protein and were checked for chemical analysis. The calcium and phosphorus content of the ration was also balanced within a ratio of 1.60-1.65 to 1. One percent cod-liver oil was included in an all-mash ration to insure sufficient vitamin D. The three peanut products in this experiment, ground peanuts with shells, ground peanuts without shells, and peanut meal, were fed in the order named in lots 3, 4, and 5, as the only protein supplement; in lots 6, 7, and 8, in combination with dried buttermilk; in lots 10, 11, and 12, in combination with dried buttermilk and meat scraps. As controls, a combination of dried buttermilk and meat scraps was fed as protein supplements in lot 1, dried buttermilk in lot 2, and meat scraps in lot 9.

Table 39. Formulas and composition of rations used.

Ingredient of ration	Lot	Lot	Lot	Lot	Lot	Lot	Lot	Lot	Lot	Lot	Lot	Lot	Lot	Lot	Lot	Lot
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Pound of ingredients used in formulas																
Yellow corn meal.....	59	49	34	44	56	42	46	52	60	47	52	58	50	53	57	
Wheat shorts.....	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	
Alf. leaf meal.....	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
Dried buttermilk.....	5	25	.....	.....	.....	13	13	13	.....	.....	.....	.....	6	6	6	
Meat scrap.....	10	.....	.....	.....	.....	.....	.....	.....	14	7	7	7	5	5	5	
Gr. peanuts with shells.....	.....	.....	40	.....	.....	20	.....	.....	.....	20	.....	.....	13	.....	.....	
Gr. peanuts without shells.....	.....	.....	.....	30	.....	.....	15	.....	.....	.....	15	.....	.....	10	.....	
Peanut meal.....	.....	.....	.....	.....	18	.....	.....	9	.....	.....	.....	9	.....	.....	6	
Composition of rations (percent)																
Crude protein.....	17.2	17.7	17.6	17.7	17.7	17.8	17.8	17.8	17.7	17.7	17.7	17.2	17.2	17.2	17.2	
Fiber.....	4.1	3.7	10.2	4.8	5.2	7.0	4.0	4.4	4.2	7.2	4.3	4.7	6.0	4.1	4.4	
Fat.....	5.2	4.0	17.4	17.7	5.7	10.7	10.9	4.9	5.6	11.5	11.7	5.7	8.9	9.1	5.1	

Table 40. Average weight, feed consumption, and percentage mortality for different lots of chickens.

Lot number	Average weight (lbs.)	Feed consumed per chick (lbs.)	Av. percentage mortality
1	0.989	3.46	5.77
2	0.085	3.50	4.80
3	0.363	2.17	40.0
4	0.335	1.94	36.43
5	0.501	2.35	40.60
6	0.874	3.03	7.26
7	0.865	2.89	8.61
8	1.002	3.61	5.39
9	0.853	3.09	7.35
10	0.697	2.96	8.43
11	0.513	2.36	33.04
12	0.792	2.85	10.98
13	0.915	3.38	3.52
14	0.873	3.42	5.22
15	0.967	2.97	3.98

Reference: Alabama Agricultural Experiment Station Circular 80, "The Value of Peanuts and Peanut Meal in Rations for Chickens" pages 8, 9, and 10, tables 6 and 7, November 1937, Auburn, Alabama.

Feeding Crossbred Chicks on Rations with Different Percentages of Proteins

Conducted by: Delaware Agricultural Experiment Station.

Conducted at: Newark, Delaware.

Period: November 30, 1937 to February 15, 1938.

Purpose: To compare feeds of different protein levels with growing chicks.

Procedure and conditions: Chicks hatched on November 30, 1937 were placed in brooders the following day, 207 chicks being placed in each of four brooders. The chicks were crossbred obtained by crossing Barred Plymouth Rock males with Rhode Island Red females. They were placed in pens with concrete floors 10 x 14 feet in an open front, shed roof long brooder house. Each pen had a concrete sun porch 10 x 12 feet. On the brooding pen floors a sugarcane by-product and peanut hulls were used as litter; on the sun porch shredded corn stover was used. Each brooding pen was equipped with a coal-burning brooder stove with a 56-inch hover.

The all-mash rations were kept before the chicks at all times. Also chick size oystershell and granite grit were always available. Each pen was equipped with an automatic drinking fountain.

Group weighings were made at intervals of two weeks for the first 10 weeks. At the end of 11, 12, 13, and 14 weeks, the chicks were weighed individually and, when a weight of 2.75 pounds or more was attained they were removed and sold.

Table 41. Rations, gains, and pounds of feed consumed per chick.

Ingredients	Percentages of protein			
	16.3	18.3	20.4	22.3
Percentages of ingredients in rations				
Ground yellow corn	43.1	40.1	37.3	34.4
Wheat bran	14.4	13.3	12.4	11.4
Flour wheat middlings	14.4	13.3	12.4	11.4
Ground oat groats	10.7	10.0	9.3	8.6
Meat scraps (55 percent)	6.5	10.0	13.8	17.2
Dried buttermilk	4.3	6.7	9.2	11.4
Alfalfa leaf meal	4.7	4.7	4.7	4.7
Steamed bonemeal	1.0	1.0	—	—
Salt	0.7	0.7	0.7	0.7
Cod-liver oil concentrate	0.2	0.2	0.2	0.2
Average weights of chicks in pounds				
Age in weeks				
Initial	0.078	0.077	0.078	0.077
2	0.198	0.221	0.250	0.249
4	0.476	0.546	0.604	0.526
6	0.904	0.995	1.110	1.042
8	1.389	1.538	1.562	1.581
10	1.856	2.063	2.095	2.117
11	2.207	2.397	2.439	2.469
Average pounds feed consumed per chick				
2	0.30	0.31	0.32	0.33
4	0.74	0.80	0.83	0.81
6	1.34	1.40	1.47	1.41
8	1.95	2.00	2.03	2.03
10	2.33	2.51	2.46	2.47
11	1.40	1.40	1.40	1.41

Higher protein levels were obtained by increasing the amounts of dried buttermilk and meat scraps, but approximately the same ratio between these two ingredients was maintained in the four rations. In order to keep the mineral content below the point where perosis might occur, steamed bonemeal was not included in the two higher protein rations. The percentages of fiber in the rations ranged from 4.2 in the ration of lowest protein content to 3.6 in that of the highest; the percentages of ash from 5.5 in the lowest to 7.6 in the highest.

Formulas for the four rations, the average bi-weekly weights of the chicks, and the average pounds of feed consumed by the chicks at different ages are given in table 41.

Table 42. Feeding crossbred chicks on rations with different percentages of protein.

Factors	Percentages of protein			
	16.3	18.3	20.4	22.3
Number of chicks at start	207.0	207.0	207.0	207.0
Percentage mortality	2.4	3.9	3.9	8.2
Number days on feed	77.0	77.0	77.0	77.0
Initial av. wt. per chick, lbs.	0.078	0.077	0.078	0.077
Final av. wt. per chick, lbs.	2.207	2.397	2.439	2.469
Av. gain per chick, lbs.	2.129	2.320	2.361	2.392
Av. lbs. feed consumed per chick.	8.06	8.42	8.51	8.36
Lbs. feed required per lb. gain	3.78	3.63	3.60	3.69
Cost of ration in dollars per 100 lbs.	2.10	2.23	2.36	2.49

Del. Exp. Sta. Bul. 210.

Reference: Agricultural Education Vol. 15, No. 4, pages 51, 52, and 53, tables 2 and 3, December 1938, Clemson, South Carolina.

VITAMINS

Vitamin A is essential to the normal growth of chicks. Its absence brings on uneven, stunted growth, and causes adult fowls to have swollen eyes, as in roup. This vitamin is found in green feeds, yellow corn, milk, egg yolk, and cod-liver oil. Plans must be made to include such materials in the ration. Vitamin A supplied in sufficient quantities gives a healthier chick, less susceptible to disease.

Vitamin B is believed to be largely destroyed by heat so that materials containing it are more likely to function when raw than when cooked or heated. It is found in green leaves of plants, milk and its products, whole cereal grains and other seeds, unpolished rice, pasture crops, eggs, and yeast. Its absence hampers growth, creates poly-neuritis, prevents normal development of internal organs or secretion, and usually results in the loss of appetite. A ration composed of the usual feeding stuffs will supply adequate vitamin B.

Vitamin C is the anti-scorbutic vitamin and is not considered of great importance in feeding poultry.

Vitamin D is very essential in poultry feeding. Lack of it prevents chicks from forming bones properly so that leg weakness and rickets occur. The deposit of lime and phosphorus in the form of bone tails to take place. This vitamin is furnished in poultry feeding largely through cod-liver oil. Ultra-violet rays, as sunlight not strained through glass, produces the effect of

vitamin D. The exposure of birds to direct sunlight is the most practical means of supplying this vitamin.

Vitamin E is present in some animal feeds. It is abundant in green alfalfa, cooked lean meat, and rice. Its presence in rations is necessary for reproduction in animals.

Vitamin G was formerly considered a member of the B group but is believed to be heat-stable and is not destroyed by ordinary cooking. Its absence causes loss of weight, retardation of growth, reduced hatchability and nutritional paralysis. The sources of vitamin G are green leaves of plants, milk and its products, whole cereal grains and other seeds, unpolished rice, pasture crops, eggs, and yeast.

Suggestive Questions

1. Are vitamins essential in a broiler's ration?
2. How should vitamins be supplied?
3. From an economical standpoint can a person afford to leave some of the vitamins out of the broiler's ration?
4. How does the young chick use the vitamins?

Vitamin A Requirements of Growing Chicks

Conducted by: New Hampshire Agricultural Experiment Station.

Conducted at: New Brunswick, New Hampshire.

Period: 1933-1934.

Purpose: (1) To determine the efficiency of various levels of cod-liver oil in the supply of an adequate amount of Vitamin A to growing chicks. (2) To study the effect on growth of previously stored up vitamin A, if any, when the ration was later changed to a deficiency basis. (3) To determine the relative amount of vitamin A in sardine oil and its ability to prevent the occurrence of ophthalmia.

Procedure and conditions: This experiment involved the use of eleven groups of 50 New Hampshire Red chicks, or a total of 550 chicks. The test groups were fed in growing batteries as follows:

1. Basal ration—deficient in vitamin A
140 pounds wheat bran
140 pounds ground oats
45 pounds meat scraps (50 percent protein)
2. Basal plus 1 percent cod-liver oil
3. Basal plus 2 percent cod-liver oil
4. Basal plus 3 percent cod-liver oil
5. 4-12 weeks control
(25 chicks from Group 9 were removed at end of 4-week period and fed only basal ration from then till end of period)
6. 8-12 weeks control
(25 chicks from Group 9 were removed at end of 8-week period and fed only basal ration from then till end of period)
7. Basal ration for first 2 weeks and then basal ration plus 1 percent cod-liver oil.
8. Basal ration plus $\frac{1}{2}$ percent sardine oil
9. New England College Conference ration (check group)

All chicks were wing-banded and weighed individually by weekly periods with sex notation being made as soon as possible for subsequent weight and growth analysis. Feed consumption was recorded weekly. All mortality was tabulated and autopsy records preserved for analysis.

Groups 1 and 3 inclusive were treated daily with ultra-violet light for a period of 15 minutes at 30 inches distant. This provision was made to furnish a supply of vitamin D to all groups above their normal requirements.

Group 8 was used to determine the relative amount of vitamin A in sardine oil and its ability to prevent the occurrence of ophthalmia.

Group 1 showed materially slower growth and presence of a vitamin A deficiency was noted in all chicks but one. Swelling of the eye and some indications of watery eyes were present at four weeks of age. A few chicks which died between nine and ten weeks of age exhibited heavy urate deposits over kidneys which were themselves grayish in color. Nodules in throat and esophagus were found in two chicks upon autopsy.

Groups 2, 3, and 4 showed very little difference in weight gains indicating that the 1 percent cod-liver oil supplied sufficient vitamin A both for prevention of ophthalmia and optimum growth. Additional amounts were not used more efficiently when comparing growth and freedom from vitamin A deficiency.

Group 9 (check) receiving the New England College Conference ration weighed at the end of the 12-week period 2.897 pounds per chick average. This was approximately a one-half pound heavier average per chick than the 1, 2 or 3 percent cod-liver oil groups on basal ration.

The 4 to 12 week control group, No. 5, showed continued normal gains up to the eighth week. After this time the growth rate was reduced and the final weight at 12 weeks showed a loss over the weight at 11 weeks of age. This indicates that there was apparently enough storage of vitamin A for about four weeks of normal growth. After this period the demand for vitamin A was in excess of the body supply.

Group 6, known as 8 to 12 week control group, after being removed from group 8 at eight weeks of age, showed continued gains. The rate of growth however, was somewhat less than that of group 9. The demand for vitamin A after the eight-week period seems to be in excess of the amount stored up and may be the result of the reduced body gains.

Group 7 which received no vitamin A supply during the first two weeks of life, but received 1 percent oil in the basal ration from 3 to 12 weeks of age showed better weight gains than did group 2. Group 2 received 1 percent cod-liver oil plus basal ration for entire period. There was, however, between the ages of two and seven weeks a slackening of weight gains as compared to group 2. It should be stated that the sex ratio of males to females in group 2 was 1:1.9 and that in group 7 was 1:1.

Apparently the reserve supply of vitamin A in the baby chick upon hatching was materially reduced during the first two weeks of life. Following this period five weeks were used to secure from the 1 percent cod-liver oil ration enough vitamin A to replenish the reserve supply and to continue growth with more normal gains. By the actions of this group there is indicated a method of determining vitamin A transfer from the breeder to the baby chick based on livability and growth.

Group 8, fed the basal ration plus one-half percent sardine oil, showed slightly less weight gains than did the cod-liver oil groups. The final average weight per chick at the end of the twelve-week period was 2.097 pounds as compared with the 1 percent cod-liver oil fed group of 2.397 pounds. At

no time during the course of the experiment were there any symptoms of a vitamin A deficiency.

In the analysis of the table giving the feed consumption per chick per week there is indicated a direct relationship between groups 2, 3, and 4 in both total consumption and in feed consumption per pound of gain. The group receiving 3 percent cod-liver oil plus the basal ration was more efficient in feed consumption as evidenced by gain in weight than were the

Table 43. Average weight in pounds per chick of the various groups by weekly periods

Week	Group								
	1	2	3	4	5	6	7	8	9
Initial.....	.0876	.0872	.0890	.0880	—	—	.0888	.0878	.0891
1.....	.1029	.1142	.1114	.1108	—	—	.1169	.1169	.1268
2.....	.1710	.1843	.1851	.1765	—	—	.1837	.1891	.2094
3.....	.2435	.2811	.2556	.2583	—	—	.2245	.2443	.3238
4.....	.3419	.3981	.3583	.3571	.4860	—	.3363	.3214	.4632
5.....	.4678	.5969	.5265	.5079	.6150	—	.5154	.4750	.6872
6.....	.5582	.8033	.6921	.6786	.8280	—	.7300	.6687	.9185
7.....	.6595	.9616	.9041	.9380	1.045	—	.9568	.8500	1.194
8.....	.7866	1.286	1.163	1.202	1.337	1.448	1.277	1.118	1.498
9.....	.9597	1.521	1.407	1.489	1.585	1.720	1.591	1.378	1.867
10.....	1.066	1.786	1.725	1.738	1.730	2.043	1.926	1.611	2.231
11.....	1.205	2.083	1.984	2.117	1.878	2.303	2.283	1.875	2.605
12.....	1.217	2.397	2.322	2.398	1.864	2.552	2.588	2.097	2.897

Table 44. Feed consumption per chick per week for all groups.

Week	Group								
	1	2	3	4	5	6	7	8	9
1.....	.085	.078	.082	.115	—	—	.093	.095	.095
2.....	.186	.207	.217	.168	—	—	.191	.228	.207
3.....	.261	.346	.292	.287	—	—	.352	.269	.308
4.....	.378	.420	.348	.370	—	—	.352	.248	.405
5.....	.646	.642	.554	.500	.600	—	.579	.548	.643
6.....	.621	.827	.719	.697	.860	—	.863	.712	.738
7.....	.865	.982	.640	.965	1.220	—	1.022	.900	1.014
8.....	.712	1.130	1.323	1.048	1.360	—	1.238	1.012	1.132
9.....	.875	1.357	1.365	1.211	1.367	1.364	1.693	1.080	1.232
10.....	.972	1.333	1.350	1.413	1.625	1.500	1.488	1.342	1.433
11.....	.950	1.850	1.516	1.637	1.166	1.282	1.670	1.555	1.559
12.....	.866	1.711	1.650	1.258	1.208	1.304	1.556	1.430	1.672
Total.....	7.417	10.883	10.056	9.669	9.406	5.450	11.097	9.519	10.438
Feed per lb. gain.....	6.09	4.54	4.33	4.032	6.82	4.93	4.28	4.53	3.63
Ratio of males to females..	1:1.3	1:1.9	1:0.87	1:1.9	1:2.43	1:1.55	1:1	1:1.4	1:6.1

Table 45. Mortality.

	Number	Percent	Major cause
Group 1	20	40.0	Vitamin deficiency
Group 2	8	16.0	Pneumonia
Group 3	8	16.0	Pneumonia
Group 4	13	26.0	Pneumonia
Group 5	1	4.0	Pneumonia
Group 6	1	4.0	Pneumonia
Group 7	10	20.0	Pneumonia
Group 8	10	20.0	Pneumonia
Group 9	5	10.0	Pneumonia
Average for all lots		17.3	

cod-liver oil fed groups. The order of efficiency is approximately the same as that evidenced in previous years' tests. The check group receiving the New England College Conference ration was the most efficient with but 3.6 pounds of feed per pound gain up to 12 weeks of age.

Reference: New Jersey Agricultural Experiment Station Bulletin 310, "Vitamin 'A' Requirements of Growing Chicks," pages 2, 13, 14, and 15, tables 6, 7, and 8, November 1938, New Brunswick, New Jersey.

The Vitamin D Requirements of Growing Chicks

Conducted by: Pennsylvania Agricultural Experiment Station.

Conducted at: State College, Pennsylvania.

Period: 1932-1933

Purpose: To determine the vitamin D requirements of growing chicks.

Procedure and conditions: Ten groups each consisting of 200 Single Comb White Leghorn chicks of the Pennsylvania State College strain were hatched and placed on experiment April 12, 1932. Each chick was individually weighed and wing-banded at hatching time. These chicks were subjected to the following experimental conditions.

Table 46. Experimental conditions.

Group Number	Environmental conditions 0 to 12 weeks	Percent cod-liver oil concentrate in total ration	U. S. P. units vitamin D per 100 grams feed
1	Battery brooder—confined	None	0
2	Battery brooder—confined	1/32	10
3	Battery brooder—confined	1/16	19
4	Battery brooder—confined	1/8	39
5	Battery brooder—confined	3/16	58
6	Battery brooder—confined	1/4	78
7	Battery brooder—confined	3/8	116
8	Battery brooder—confined	1/2	155
9	Colony brooder house—limited range	None	0
10	Colony brooder house—limited range	1.8	39

Table 47. Rations.

	Starting mash* pounds	Growing and laying mash† pounds
Ground yellow corn	43.5	45.5
Wheat bran	10.0	10.0
Standard wheat middlings	10.0	10.0
Alfalfa meal	5.0	5.0
Meat scraps (55 percent protein)	10.0	7.5
Dried skim milk	10.0	7.5
Ground heavy oats	10.0	10.0
Ground limestone (98 percent CaCO ₃)	1.0	4.0
Salt	0.5	0.5
Total	100.0	100.0
Percent protein	18.4	16.40
Percent calcium	1.47	2.79
Percent phosphorus	0.92	0.80

*Fed from 1-day old to 12 weeks. †Fed from 12 to 76 weeks of age.

Groups 1 to 8 were brooded in batteries, each deck of which was heated indirectly by hot water so that all decks could be maintained at a uniform tem-

perature. The brooders were located in a well ventilated room equipped with auxiliary heat. No direct rays of the sun were allowed to enter the room.

Groups 9 and 10 were brooded in colony brooder houses of similar size and construction, and heated with hard coal-burning brooder stoves. Limited range was provided for these two groups throughout the entire year in order that the chicks might be exposed to direct sunlight. All groups (1 to 10 inclusive) were fed the all-mash rations shown in table 47.

When four weeks old, cockerels from all groups were removed. At 12 weeks of age, 65 representative pullets from each of the 10 groups were transferred to the laying pens. Body weight, health, condition, physical development, and state of maturity were considered in making the selection. At this time the growing and laying mash was substituted for the starting mash. The 19 groups of pullets were housed in a long continuous type of laying house. Direct sunlight was excluded from the pens in which the confined pullets were housed. All pens were of similar construction except the fronts of the two pens in which the range-reared pullets were housed. The fronts of these two pens were arranged to allow direct sunlight to enter. The pullets of the range-reared groups had access at all times to approximately one-fourth acre of alfalfa range.

Table 48. Vitamin D requirements for growing chicks.

Group number	1	2	3	4	5	6	7	8	9	10
U.S.P. units vitamin D per 100 grams feed	0	10	19	39	58	78	116	155	0 Range	39 Range
Weeks	Average body weight of pullets in pounds									
8	0.66	0.98	1.19	1.23	1.19	1.22	1.16	1.18	1.18	1.24
16	1.34	1.92	2.49	2.50	2.59	2.33	2.46	2.33	2.61	2.61
24	*	2.57	3.35	3.40	3.37	3.38	3.42	3.32	3.54	3.62
	Pounds of feed consumed per pullet to date									
0 to 8	2.58	3.08	3.63	3.60	3.55	3.61	3.49	3.56	3.76	3.97
0 to 16	6.26	7.95	10.10	10.35	10.38	10.18	9.90	10.03	10.95	11.30
0 to 24	*	15.01	19.46	19.67	19.65	19.64	10.28	20.03	19.97	21.48
	Intake of U.S.P. units of vitamin D from ration per pullet to date									
0 to 8	0	136	320	649	936	1,267	1,841	2,497	0	697
0 to 16	0	351	889	1,819	2,739	3,576	5,223	7,089	0	1,984
0 to 24	*	661	1,712	3,457	5,183	6,902	10,171	14,119	0	3,774

*Group 1 was discontinued at 16 weeks.

Reference: Pennsylvania Agricultural Experiment Station Bulletin 334, "Vitamin D for Chicks and Hens," pages 2, 4, and 9, table 1, August 1936, State College, Pennsylvania.

Vitamin D for Chicks

Conducted by: Pennsylvania Agricultural Experiment Station.

Conducted at: State College, Pennsylvania.

Period: 1934-1935.

Purpose: To determine the amount of Vitamin D required for growing chicks.

Procedure and conditions: For the 1934-35 experiment, 1,575 Single Comb White Leghorn chicks of the Pennsylvania State College strain, hatched November 22, 1933 were used. Nine groups each containing 175 selected chicks

were weighed, wing banded and placed in individual brooding pens. The chicks were confined in 12 x 20 foot pens in a long continuous type of brooder house. The pens were similarly constructed and equipped. In order to exclude direct sunlight the windows of each pen were covered with a soap compound.

Each group of chicks was fed the same basal all-mash rations as were used in the 1932-33 experiment. To the ration of each group were added the following amounts of cod-liver oil concentrate.

Table 49. Amount of cod-liver oil used.

Group Number	Percent cod-liver oil concentrate in total ration	U.S.P. units vitamin D per 100 grams feed
1	0	0
2	1/16	19
3	1/8	39
4	3/16	58
5	1/4	78
6	5/16	97
7	3/8	116
8	1/2	155
9	1	310

All cockerels were removed at an early age. On account of the severe rachitic condition of the pullets in group 1 (no vitamin D) this group was discontinued at the end of the eighth week. Between the 12th and 13th weeks of the experiment the starting mash was replaced with the growing and laying mash. At 16 weeks of age, 55 representative pullets from each of the remaining eight groups were selected for the laying pens. Body weight, health, condition, physical development, and state of maturity were considered in the selection. The pullets were housed in the same laying house and kept under the same environmental conditions as were the confined pullets of the 1932-33 experiment. Precautions were taken to prohibit any ultra-violet light from entering the pens in which the pullets were confined.

Table 50. Vitamin D for chicks.

Group number	1	2	3	4	5	6	7	8	9
U.S.P. units vitamin D per 100 grams feed	0	19	39	58	78	97	116	155	310
Weeks	Average body weight of pullets in pounds								
8	0.65	1.14	1.22	1.23	1.19	1.25	1.25	1.26	1.26
16	*	2.62	2.76	2.76	2.63	2.65	2.73	2.69	2.65
24	—	3.40	3.53	3.59	3.42	3.53	3.65	3.60	3.65
	Pounds of feed consumed per pullet to date								
0 to 8	2.74	3.90	3.91	4.02	3.84	3.92	3.88	4.20	3.95
0 to 16	*	11.94	12.67	12.88	12.27	12.49	12.58	13.00	12.74
0 to 24	—	24.20	25.58	26.04	24.73	25.86	25.74	26.42	25.75
	Intake of U.S.P. units of vitamin D from ration per pullet to date								
0 to 8	0	342	687	1,057	1,347	1,720	2,041	2,954	5,550
0 to 16	*	1,048	2,227	3,390	4,307	5,487	6,620	9,136	17,898
0 to 24	—	2,125	4,495	6,860	8,686	11,363	13,556	18,570	36,189

*Group 1 was discontinued at 8 weeks.

Reference: Pennsylvania Agricultural Experiment Station Bulletin 334, "Vitamin D for Chicks and Hens," pages 11, 12, and 13, table 2, August 1936, State College, Pennsylvania.

Vitamin D. Requirements of Growing Chicks as Affected by The Calcium Content of the Ration

Conducted by: Texas Agricultural Experiment Station.

Conducted at: College Station, Texas.

Period: 12 weeks.

Purpose: To determine the vitamin D requirements of growing chicks.

Procedure and conditions: White Leghorn chicks from the Poultry Division of the Texas Station were used. The hens from which those chicks were hatched were running on free range in sunlight and adequate green food was available at all times. The chicks were hatched in a forced draft incubator and kept in a battery brooder room from which all outside sunlight was excluded, and were allowed a 14-hour feeding period each day. Feed was weighed to the chicks daily and fresh tap water was available at all times.

Two series of rations were fed to duplicate groups of chicks in two experiments.

In the first experiment using the first ration, 1.1, 1.9, and 2.6 International units of vitamin D were fed with 1.31 percent calcium and 1.1, and 1.9 International units of vitamin D were fed with 1.50 percent calcium.

Table 51. Basal ration used in the first experiment.

Meat and bone scraps	6 percent
Cottonseed meal	6 percent
Dried buttermilk	6 percent
Dehydrated alfalfa leaf meal	3 percent
Wheat gray shorts	20 percent
Salt	1 percent
Ground yellow corn	58 percent

Table 52. Basal ration used in second experiment.

Meat and bone scraps	6 percent
Cottonseed meal	6 percent
Dried buttermilk	6 percent
Dehydrated alfalfa leaf meal	3 percent
Wheat gray shorts	30 percent
Salt	1 percent
Ground yellow corn	48 percent

Table 53. Relation of vitamin D and calcium to gain in weight, rickets, and other criteria on chickens fed ration 1, experiment 1

Percent calcium in ration	1.31			1.50	
International units of vitamin D per 100					
grams ration	1.1	1.9	2.6	1.1	1.9
Mean gain of cockerels	1.441	1.724	1.860	1.620	1.900
Mean gain of pullets	1.128	1.295	1.591	1.397	1.563
Lbs. of feed required to produce one lb. of gain	4.61	4.17	3.98	4.44	3.95
Mean percent of bone ash	40.16	43.54	45.00	42.01	44.31
Percent of chicks that had crooked breast bones	58.3	27.1	4.2	14.9	2.0
Percent of chicks that had rickets	68.8	25.0	4.2	25.5	2.0
Number chicks that died during experiment	3	4	4	5	2

In the second experiment using the second ration, 1.2, 2.4, and 3.6 International units of vitamin D were fed with 1.51 and 1.71 percent calcium.

The vitamin D was supplied by a cod-liver oil which contained 26.7 International units of vitamin D per gram. In varying the calcium content of the rations, oystershell replaced an equal amount of ground yellow corn. The percentages of oystershell used with the first ration were 1 and 1.5 percent and with the second ration were 1.5 and 2 percent. The phosphorus content of the first and second rations was 0.76 and 0.81 percent respectively.

Table 54. Relation of vitamin D and calcium to gain in weight, rickets, and other criteria on chickens fed ration 2, experiment 2.

Percent calcium in ration	1.51			1.71		
International units of vitamin D						
per 100 grams ration	1.2	2.4	3.6	1.2	2.4	3.6
Mean gain of cockerels	1.571	1.802	1.978	1.577	1.735	2.000
Mean gain of pullets	1.415	1.343	1.672	1.319	1.613	1.599
Lbs. of feed required to produce one lb. gain	4.10	3.95	3.67	4.19	3.84	3.82
Mean percentage of bone ash	41.55	43.95	47.05	42.63	45.61	46.50
Percent of chicks that had crooked breast bones	37.5	7.0	0.0	20.8	0.0	0.0
Percent of chicks that had rickets	37.5	14.0	0.0	10.4	0.0	0.0
No. of chicks that died during experiment	7	7	8	16	13	7

Reference: Poultry Science Vol. XVI, No. 2. "Vitamin D Requirements of Growing Chicks As Affected by the Calcium Content of the Ration," pages 106, 107, tables 1 and 2, March 1937.

The Effect of Different Sources and Amounts of Vitamin G Feeds on Growth of Chicks

Conducted by: Cornell University Agricultural Experiment Station.

Conducted at: Ithaca, New York.

Period: 8 weeks.

Purpose: To determine the effect of different sources and amounts of vitamin G feeds on the growth of chicks.

Procedure and conditions: In the work with chicks, a basal diet, composed largely of ground yellow corn, wheat-flour middlings, and purified casein, was fed. The protein content of this diet was standardized at 25 percent protein, moisture-free basis. The proportions of the various ingredients used in a typical basal diet are shown.

Table 55. Chick basal diet.

	Percent
Ground yellow corn	60.0
Wheat-flour middlings	20.0
Purified casein	15.5
Steamed bonemeal	2.0
Pulverized limestone	1.0
Salt, iodized	0.5
Cod liver oil	1.0

The vitamin G carriers were incorporated in the basal diet in such a way as to keep the protein content at 25 percent. This was accomplished by making such adjustments in the quantity of ground corn and of casein in these diets as would compensate for the protein content of the sources of vitamin G.

White Leghorn chicks of the Cornell strain were used in the experiment-

al work. In general, 25 chicks were put in each lot. The chicks were weighed individually at weekly intervals throughout the experiment. All the growth data were weighed for sex influence by averaging the average weights for each sex.

Table 56. Effect of feeding graded quantities of vitamin G on growth of chicks.

A. Yeast autoclaved for 6 hours at 121° C., 25 chicks in each lot

Diet	Average weight of chicks at 8 weeks (lbs.)
No yeast	.359
2.5 percent yeast	.820
5 percent yeast	1.187
10 percent yeast	1.350

B. Liver extract, protein-free, 25 chicks in each lot

No liver extract	.399
0.23 percent liver extract	.846
0.47 percent liver extract	1.185
0.70 percent liver extract	1.396

C. Dried skimmilk, 25 chicks in each lot

No dried skimmilk	.554
2 percent dried skimmilk	.794
4 percent dried skimmilk	1.051
6 percent dried skimmilk	1.270
8 percent dried skimmilk	1.219
10 percent dried skimmilk	1.115
12 percent dried skimmilk	1.340
14 percent dried skimmilk	1.292

D. Dried whey, 25 chicks in each lot

No dried whey	.359
0.63 percent dried whey	.444
1.25 percent dried whey	.575
2.5 percent dried whey	.618
5 percent dried whey	1.228
10 percent dried whey	1.294

It is evident also that the growth response obtained by feeding graded quantities of vitamin G decreases rapidly at the higher levels, and finally approaches zero, in accordance with the "law of diminishing increment" (Spillman, 1924). This is an illustration of the commonly observed phenomenon, that inherited growth regulators come into play and prevent the ingestion of an excess quantity of an essential nutritive factor from having any stimulative effect on the rate of growth which is normal for the species.

Reference: Cornell University Agricultural Experiment Station Bulletin 660, "The Vitamin G Requirement of Poultry," pages 3, 4, 6, and 7, table 5, September 1936, Ithaca, New York.

MINERAL SUPPLEMENTS

Are minerals necessary in a broiler's ration?

What are minerals?

Minerals are sometimes referred to as ash including those mineral compounds which are a part of bones and tissues, eggs, shells, and feedstuffs, essential for normal, strong tissues and bony framework. Calcium or its forms, is probably the most important mineral required, and in combination with phosphorus and magnesium, is an important part of the bone. Other min-

erals probably required in poultry rations are potassium, silicon, sulphur, chlorine, sodium, iodine, iron and manganese.

How are minerals used by the broiler?

Minerals are used for body maintenance. As has already been stated the broiler's body is made up of approximately 4 percent minerals. Minerals are essential for proper bone development.

Minerals also appear to assist in the more complete digestion of proteins and other nutrients. It has been found that mineral contents of grain feeds is not enough to meet the needs of the laying hen. Therefore, the required amount of mineral must be supplied from other sources.

Meat protein sources contain considerably more minerals than the grain sources of protein. This fact should be considered in feeding the broiler.

Sodium, chlorine, phosphorus, and calcium are the minerals most commonly deficient in the broiler's ration. The sodium and chlorine may be supplied very easily by the addition of a small amount of salt in the ration. Calcium may be supplied by using oystershell or limestone. This mineral is one of the most important and should be supplied in sufficient quantities at all times.

Suggestive Questions

1. Why are minerals needed in a broiler ration?
2. What minerals are needed by broilers?
3. How may minerals be supplied?
4. What would be the results if minerals were not supplied in a broiler ration?

Limestone Grit Desirable

A ration of corn, middlings, milk, and salt will produce good results if chicks are allowed to run out in the sunshine in the late spring and summer. Such a ration is too low in calcium if the chicks are brooded inside. Several trials have shown that late April or early May chicks can be raised from baby chicks to maturity on the simple ration above if they can run out in the sunshine as in a sand-gravel yard. That inside chicks require more minerals is shown in table 57.

Table 57. Effect of adding minerals to simple ration.

	Windows closed quartz lamp		Sunshine open windows		Windows closed		Windows closed cod-liver oil	
	No mineral lot 3	Mineral addition lot 4	No mineral lot 5	Mineral addition lot 6	No Mineral lot 7	Mineral addition lot 8	No mineral lot 9	Mineral addition lot 10
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Wt. at start	.075	.085	.085	.085	.085	.085	.087	.087
2nd wk.	.204	.209	.197	.206	.164	.202	.195	.195
6th wk.	.554	.634	.583	.618	.234	.596	.590	.577
8th wk.	.823	.985	.853	.915	Died	.832	.813	.878
Percent died.....	18	2	6	0	100	2	2	2
Av. percent ash..	40.88	41.85	39.06	42.37	24.81	36.95	24.81	42.48
Blood calcium ...	11.19	12.57	11.88	11.69	8.54	10.75	9.65	11.78
Blood phosphorus	6.00	5.23	6.99	6.37	3.70	4.48	6.71	7.00

Basal Ration made of: Yellow corn, 65; Wheat middlings, 16; Dried milk, 18; Salt, 1.

No minerals groups—Basal	100
Mineral groups—Basal	95
Limestone	2
Steamed bone	3
	100

Single Comb White Leghorns confined inside: shaving litter.

Reference: Wisconsin Agricultural Experiment Station Bulletin 434, "Chick Feeding," page 9, table 3, February 1936, Madison, Wisconsin.

Salt Additions Desirable

Good chicks have been grown at the Station with rations that did not contain any common salt (sodium chloride) addition. Rations that carried as much as 5 percent of common salt appear to be mildly injurious. It is true that generous supplies of chlorine are needed to make hydrochloric acid in the stomach which aids in protein digestion. The results seem to show quite definitely that it is well to add from one-half to one pound of salt to each 100 pounds of chick mash.

Single Comb White Leghorns, sand yards, shavings litter, sunshine.

Basal ration consisted of ground yellow corn, 45; wheat bran, 15; standard middlings, 15; dried milk, 12; meat scrap, 6; alfalfa leaf meal, 3 and limestone grit, 3.

The results of this trial indicated that 5 percent of salt was more than was desirable.

Table 58. Is salt a desirable addition to a chick ration?

Rations		Average weights of chicks in pounds			
		Start	4 wks.	8 wks.	12 wks.
Lot 5B					
Basal	100				
Salt	0	.083	.365	.900	1.67
Lot 6B					
Basal	99				
Salt	1	.092	.405	1.06	1.82
Lot 7B					
Basal	95				
Salt	5	.090	.361	.885	1.63

Reference: Wisconsin Agricultural Experiment Station Bulletin 434, "Chick Feeding," page 10, table 4, February 1936, Madison, Wisconsin.

HOME-MIXED AND SIMPLIFIED RATIONS

In producing broilers it is necessary to reduce the feed cost to a minimum.

Many broiler producers use commercial-mixed feeds. Home-mixed feeds can usually be purchased at lower prices than factory-mixed feeds. Information is presented comparing home-mixed and factory-mixed feeds.

Suggestive Questions

1. Are home-mixed rations cheaper than factory-mixed?

ingredient serves a special purpose. Substitutions should not be made unless someone is consulted who is sufficiently familiar with the feeding value of ingredients to pass judgment intelligently on their interchangeability. Some poultrymen have attempted to replace milk in the chick rations with a cheaper protein feed. Such changes usually prove unsatisfactory and unprofitable.

The amount of fish oil a poultryman should use in a chick ration depends upon the richness of the oil in vitamin D. The manufacturers of better grades of fish oils include on the container specific information regarding the vitamin potency of the oil and the amount to be included in the poultry ration.

In buying ingredients for home-mixed rations careful consideration should be given to the kind and quality of the ingredients. The above rations specify yellow corn meal and not white corn meal. Rice bran is sometimes confused with rice polish and by-products. Pulverized oats should not be confused with ground oats and oat by-products. The above "by products" feeds contain too much fiber to be used satisfactory in poultry mashes.

Table 60. A comparison of simple home-mixed ration with commonly used commercial rations, Louisiana, 1939-1940.

	Ration numbers								
	1	2	3	4	5	6 ¹	7 ¹	8 ¹	
Percent mortality.....	8.00	4.00	4.00	4.00	8.00	8.00	4.00	4.00	
Av. wt. per chick at 8 weeks (pounds).....	1.25	1.00	1.28	1.17	1.22	1.22	1.12	1.43	
Cost of feed per 100 pounds (dollars)	2.51	2.20	2.39	2.39	2.41	2.35	2.58	2.31	
Feed consumed per lb. gain (pounds).....	3.45	3.57	3.21	3.36	3.32	3.39	3.19	3.26	
Feed cost per pound of gain (cents).....	8.70	7.90	7.70	8.00	8.00	8.00	8.20	7.60	
	9 ²	10 ²	11	12 ⁰	13	14x	15	16	Av. com- mercial feeds*
Percent mortality	9.33	13.33	32.00	36.00	4.00	28.00	4.00	4.00	13.50
Av. wt. per chick at 8 weeks (pounds).....	1.30	1.32	0.96	1.30	1.40	1.23	1.49	1.44	1.38
Cost of feed per 100 pounds (dollars)	2.07	2.17	2.21	2.16	2.04	2.12	2.06	2.04	3.32
Feed consumed per lb. gain (pounds).....	3.10	3.08	4.65	2.95	2.98	3.00	3.08	2.97	3.12
Feed cost per pound of gain (cents).....	6.40	6.70	8.40	6.40	6.10	6.30	6.30	6.10	10.32

¹Average of 2 tests.

²Average of 3 tests.

*4 tests, 11 feeds used in computing average

⁰In one test high mortality was due to cannibalism and in the other test the high mortality was not attributed to any one cause, this is a common occurrence in summer hatched chicks.

^xThe high mortality obtained in ration 14 was due to cannibalism.

Reference: Louisiana Agricultural Experiment Station Bulletin 330, "Home-mixed Rations for Poultry," Baton Rouge, Louisiana, February 1941.

Home-mixed Rations for Chicks

Conducted by: Future Farmer Chapter of the Seneca High School.

Conducted at: Seneca, South Carolina.

Period: 1937-1938.

Procedure and conditions: For the past few years the members of the Future Farmer Chapter of the Seneca High School, Seneca, South Carolina, have formulated and mixed rations for feeding baby chicks and pullets. They bought from local feed dealers the ingredients they could not furnish from home, weighed out the necessary amounts, and mixed their feeds with shovels on a boarded platform in the basement of the school building.

The following chick rations were formulated at the Conference of the New England Colleges in October 1936.

Chick Mash

200 pounds yellow corn meal
 100 pounds wheat bran
 100 pounds wheat flour middlings
 50 pounds meat scraps not less than 50 percent protein
 100 pounds ground oats (38-40 lbs. to the bushel of oat groats)
 50 pounds dried skimmilk or dried buttermilk
 25 pounds fish meal not less than 50 percent protein
 25 pounds alfalfa not more than 20 percent fiber
 15 pounds calcium carbonate (ground oystershell or ground limestone with a content of not less than 96 percent calcium carbonate)
 5 pounds common salt
 Add to the above 7 pounds of cod-liver oil, sardine 85 U. S. P. vitamin D units per gram, or the equivalent of cod-liver oil vitamin A and D concentrates; or the vitamin D supplement should be used as directed by manufacturers.

Chick Grain

200 pounds yellow corn
 100 pounds wheat

Table 61. Feeding home-mixed rations to Barred Rock broilers.

Student number	Number chicks bought	Number chicks raised	Number weeks fed	Total pounds feed fed	Cost of feed in dollars	Total wt. of broilers sold in pounds
1937						
1	295	270	10-12	2200	\$66.00	585
2	378	345	9-11	2755	82.65	667
3	104	92	9-11	775	23.25	187
4	203	198	8-12	1375	41.25	391
5	308	264	10-18	2100	72.40	572
6	304	266	9-12	2300	74.88	582
7	206	190	9-11	1400	42.00	389
1938						
1	308	302	8-10	2500	63.00	611
2	301	258	8-12	2300	58.50	574
3	355	335	8-11	2650	66.25	662
4	308	280	9-10	2000	50.00	570
5	308	300	9-13	2850	71.25	597
6	203	199	8-9	1500	38.00	383
7	203	192	9-12	1540	38.50	391
8	308	284	9-11	2550	63.65	583
9	254	238	9-12	2328	58.15	385

In 1937 this formula was adopted by the Seneca F. F. A. Chapter as a basal ration. A few slight changes were made to effect lower prices without weakening the feeding value of the mash. One hundred pounds yellow corn meal was used instead of ground oats, and 25 pounds of cottonseed meal or peanut meal was substituted for half the dried milk.

The mash was fed for the first six or eight weeks and the grain mixture used only after the chicks were older and in growing out the pullets. The mash was placed before the chicks at all times in small hoppers and sufficient water was always available.

In 1938 the variations made in the New England formula were similar to those made in 1937. A vegetable protein was substituted for half the dried milk and an equal amount of yellow corn meal replaced the ground oats. Concentrated cod-liver oil was used as directed by the manufacturer.

Reference: Agricultural Education, Volume 15, No. 4, pages 61 and 62, table 11, December 1938, Clemson, South Carolina.

Simplified Rations for Farm Chickens

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: Two years, 1931 and 1932.

Purpose: To compare simple rations used to feed growing chicks.

Procedure and conditions: Day-old Single Comb White Leghorn chicks of good breeding were used in this experiment. The flock from which the chicks were produced was tested for pullorum disease and rigidly selected for vigor. Permanent identification of chicks in the various lots was assured by toe-marking each chick. Each lot contained 350 chicks in 1931 and 100 chicks in 1932. All chicks were uniformly housed and brooded in confinement. Each lot of chicks was allowed to run on an 8 x 10 foot, wire-floored porch, which permitted exposure to direct sunshine and at the same time minimized the possibilities of contact with disease-producing organisms.

The chicks in all lots were fed all-mash rations which were kept before them continuously in small wooden hoppers. They were watered in fruit jar drinking fountains for the first few days and then in partially covered galvanized troughs. The control group of chicks, lot 1, was fed one of the standard complex rations which could be depended upon to produce satisfactory results. Lots 2 and 8 were fed simplified rations. The formulas of the rations fed in this experiment were:

Lot 1		Lot 2	
	Lbs.		Lbs.
Yellow corn meal	45	Yellow corn meal	100
Wheat shorts	15	Bonemeal	5
Meat scrap	2	Marble grit	5
Ground oat groats	20	Salt	1
Dried buttermilk	10	Skimmilk to drink	
Alfalfa meal	2		
Linseed oil meal	2		
Bonemeal	2		
Charcoal	1		
Salt	1		
Water to drink			
Lot 3		Lot 4	
	Lbs.		Lbs.
White corn meal	100	Yellow corn meal	80
Bonemeal	5	Wheat shorts	20
Marble grit	5	Bonemeal	5
Salt	1	Marble grit	5
Skimmilk to drink		Salt	1
		Skimmilk to drink	

Lot 5		Lot 6	
	Lbs.		Lbs.
White corn meal	80	Yellow corn meal	70
Wheat shorts	20	Wheat shorts	20
Bonemeal	5	Meat scrap	16
Marble grit	5	Bonemeal	3
Salt	1	Salt	1
Skimmilk to drink		Water to drink	

Lot 7		Lot 8	
	Lbs.		Lbs.
Yellow corn meal	75	Yellow corn meal	85
Ground oats	15	Ground oats	15
Meat scrap	16	Bonemeal	5
Bonemeal	3	Marble grit	5
Salt	1	Salt	1
Water to drink		Skimmilk to drink	

Table 62. Simplified rations for farm chicks.

CHICKS

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8
Av. weight of chick (lbs.)								
2 weeks	.190	.160	.165	.190	.180	.165	.135	.170
4 weeks	.340	.275	.265	.325	.290	.260	.205	.295
6 weeks	.625	.525	.490	.635	.585	.540	.450	.560
8 weeks	.825	.655	.590	.770	.715	.645	.560	.705
Av. feed consumption per chick (lbs.)								
Mash	2.31	1.98	2.02	2.19	2.30	1.99	2.30	2.08
Skim milk	—	2.21	2.34	2.23	2.36	—	—	2.10
Average mortality	10.0	12.1	18.3	10.4	18.5	29.5	39.9	12.8

PULLETS

Av. weight of pullets (lbs.)								
8 weeks	.825	.655	—	.770	.715	—	—	.705
12 weeks	1.67	1.33	—	1.57	1.40	—	—	1.32
16 weeks	2.21	2.03	—	2.15	2.08	—	—	2.03
20 weeks	2.41	2.36	—	2.51	2.27	—	—	2.33
Av. feed consumption per pullet (lbs.)								
Mash	8.19	6.09	—	6.45	6.10	—	—	5.74
Grain	2.67	2.32	—	1.69	1.68	—	—	2.75
Skimmilk	—	15.81	—	22.87	18.77	—	—	15.64

Five lots, 1, 2, 4, 5, and 8, were carried through the growing and laying periods. The other lots were unsatisfactory and were discontinued at the close of the brooding period. The cockerels were removed from each lot at eight weeks of age, and the pullets placed in Auburn type laying houses where they remained throughout the experiment. Each lot continued to receive the same ration which they had received during the brooding period except that whole corn was given as a scratch grain to the simplified-ration lots. Lots receiving yellow corn meal in the mash were given yellow corn as a scratch grain, and lots which received white corn meal in the mash were given white corn as a scratch grain. Lot 1, the control group, received a scratch grain consisting of equal parts of cracked yellow corn and whole wheat and was changed from the complicated starting mash to a complicated growing mash consisting of: 30 pounds yellow corn meal, 20 pounds ground oat groats, 15 pounds wheat shorts, 10 pounds wheat bran, 5 pounds alfalfa meal, 5 pounds

meat scrap, 7 pounds dried buttermilk, 3 pounds bonemeal, 3 pounds linseed meal, 1 pound charcoal, and 1 pound fine salt.

Reference: Alabama Agricultural Experiment Station Circular 66, "Simplified Rations for Farm Chickens," pages 3, 4, 5, 6, 7, and 8, tables 1, 2, 3, 4, 5, June 1934, Auburn, Alabama.

Production Costs with Growing Chicks

Conducted by: Missouri Agricultural Experiment Station.

Conducted at: Columbia, Missouri.

Period: 1931.

Procedure and conditions: The birds used in this investigation were the strains of Single Comb White Leghorns, Rhode Island Reds, and White Plymouth Rocks which have been bred at this Station for a number of years. The Leghorns and Rocks average slightly below standard weight at maturity, but the Reds are standard weight when mature.

The chicks were hatched at weekly intervals from February 7 to April 11, each hatch being numbered consecutively; thus, hatch number 3102 was hatched February 7, hatch number 3105, March 7, etc.

All chicks were placed in battery brooders when removed from the incubator and kept there for four weeks. Each chick was pedigreed, being wing-banded when removed from the pedigree baskets at hatching time. After four weeks in the battery brooders the chicks were placed in 10 x 12 foot colony houses which were heated with colony brooder stoves.

An all-mash ration was fed for the first eight weeks. This ration was placed before the chicks as soon as they were taken from the incubator and was kept before them continuously. The all-mash mixture used was:

	Pounds
Yellow corn meal	50
Bran ..	15
Shorts ..	15
Dried milk	15
Bonemeal ..	4
Cod-liver oil	1
Salt ..	1
	Pounds
Yellow corn meal	100
Bran ..	100
Shorts ..	100
Meat scrap	40
Dried milk	20
Bonemeal ..	16
Salt ..	4

When the chicks were 8 weeks old the mash was changed to the following mixture:

Beginning at eight weeks, cracked yellow corn was placed in hoppers and kept before the chicks at all times. These rations were continued until the birds were transferred to the laying house or sold.

Table 63 shows the feed consumption by 4-week intervals to the age of 12 weeks and the total up to the age of 20 weeks. The average feed consumption for the three 4-week periods was 84, 257, and 397 pounds respectively. Thus to the age of 12 weeks the total feed consumption per 100 chicks

Table 63. Feed consumption per 100 chicks—Leghorns and heavy breeds.

Hatch number	Age in weeks						Total
	0-4	4-8	8-12		12-20		
			Mash	Grain	Mash	Grain	
1	93	307	262	129	1187	587	1774
2	88	244	353	121	981	751	1732
3	82	259	288	121	873	698	1571
4	76	206	310	161	957	599	1556
5	86	261	276	133	993	448	1441
6	79	201	315	80	1048	489	1537
7	92	243	295	62	1089	490	1529
8	82	339	173	145	1005	481	1486
9	81	250	251	99	—	—	—
Average	84	257	280	117	1010	568	1578
To date	84	341	621	117	—	—	—

was 738 pounds, consisting of 621 pounds of starting and growing mash and 117 pounds of grain. To the age of 20 weeks the total feed consumption per 100 chicks was 1578 pounds. This was made up of 341 pounds of starting mash, 669 of growing mash and 568 pounds of grain.

Table 64. Rate of growth.

	Age in weeks—weight in pounds					
	Day old	4	8	12	16	20
Females						
White Leghorns	.089	.38	.99	1.62	2.17	2.50
Rhode Island Reds	.093	.40	1.06	1.88	2.67	3.36
White Rocks	.092	.37	1.05	1.82	2.54	3.23
Males						
White Leghorns	.091	.414	1.18	1.94	—	—
Rhode Island Reds	.093	.40	1.6	2.14	3.36	4.40
White Rocks	.092	.40	1.22	2.18	3.34	4.37

The weights of the pullets at the age of 12 and 20 weeks for the various hatches are shown in the table that follows. There appears a marked tendency for the birds to make less rapid growth as the date of hatch occurs later in the season. The advantage of early hatching as influencing growth is readily apparent as one compares the weight at 12 weeks of hatches No. 1 and 2 with hatches No. 8 and 9. Similar data for the cockerels are also shown in the table. In the case of the White Leghorn males in hatches 1 and 2, these birds at the age of 10 weeks were transferred to feeding batteries where they failed to make expected gains. The White Leghorn males from these hatches which were retained as prospective breeders and allowed to remain on the range average 2.25 pounds. In the remaining hatches the cockerels were retained in colony houses until marketed.

At the age of 20 weeks the advantage of early hatching is plainly evident for the general purpose breeds although not so marked for the Leghorns. The advantages of early hatching are to be found in considering the percentage of pullets which were banded and placed in laying quarters. The percentage of pullets retained from hatches 1, 2, and 3 hatched February 7 to February 21 was 78, as compared to 61 from hatches 8 and 9 hatched March 28 to April 4. In these data the Rhode Island Reds were eliminated due to a much higher degree of culling because of the failure to meet the color requirements expected of the breed.

Table 65. Influence of hatching date on growth.

Hatch	Date hatched	Weight in pound						Weight of males at 12 wks.—lbs.		
		R. I. Reds		White Rocks		White Leghorns		R. I. Reds	White Rocks	White Leghorns
		12 wks.	20 wks.	12 wks.	20 wks.	12 wks.	20 wks.			
		Pullets						Cockerels		
3101	Feb. 7	2.31	3.73	2.08	3.64	1.86	2.52	2.47	2.40	2.02
3102	Feb. 14	2.06	3.50	1.90	3.10	1.68	2.65	2.34	2.40	1.87
3103	Feb. 21	2.02	3.63	1.92	3.20	1.70	2.43	2.19	2.20	2.11
3104	Feb. 28	2.02	3.40	1.82	3.20	1.66	2.43	2.08	2.35	1.87
3105	Mar. 7	1.88	3.41	1.85	3.44	1.53	2.33	2.18	2.16	2.04
3108	Mar. 28	1.84	3.28	1.81	3.05	1.58	2.61	1.91	2.06	1.87
3109	Apr. 4	1.67	3.10	1.74	2.94	1.44	2.22	1.88	1.92	1.70
Av.		1.88	3.36	1.82	3.23	1.62	2.50	2.14	2.18	1.94

Reference: Missouri Agricultural Experiment Station Bulletin 313, "Some Production Costs With Growing Chicks," pages 3, 4, 5, 6, 7, 8, and 9, tables 3, 4, 9, and 10, July 1932, Columbia, Missouri.

Comparing Supplement Feeding with a Commercial All-Mash Chick Starter

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: Seven weeks in 1934.

Purpose: To compare supplement feeding with a commercial all-mash chick starter.

Procedure and conditions: This test consisted of two lots with 248 chicks in each lot.

Lot 1 was fed the supplement mixture and lot 2 the commercial feed.

The supplement feed consisted of:

100 pounds commercial 32 percent protein supplement.

100 pounds wheat shorts.

200 pounds corn meal.

33 pounds dried milk.

The all-mash commercial starting mash was a leading brand found in all the markets in the country.

Table 66. Average weight by weeks in pounds.

	First week	Second week	Third week	Fourth week	Fifth week	Sixth week	Seventh week
Lot 1	.115	.2	.3	.43	.54	.73	.96
Lot 2	.12	.19	.28	.40	.53	.70	.93

Reference: Unpublished information of Poultry Department, Mississippi Agricultural Experiment Station, State College, Mississippi.

The Effect of Fiber in Rations for Baby Chicks

Conducted by: Oklahoma Agricultural Experiment Station.

Conducted at: Stillwater, Oklahoma.

Purpose: To determine if possible the maximum, minimum, and optimum amounts of fiber for baby chicks.

Procedure and conditions: Six lots of 100 chicks, 55 White Leghorns, 30 Rhode Island Reds and 15 Barred Rocks were used. Each lot was selected

as uniformly as possible and placed in a battery brooder. One hundred chicks were put in each compartment which was 32 x 29 inches in size. The chicks were kept in the battery brooder house. Each lot had a pen 6 x 12 feet and a concrete sun porch of equal size. All lots were kept in this brooder house until they were moved to their laying quarters.

No green feed in any form was fed, other than what was in the ration. One percent of cod-liver oil was mixed with the feed. The chicks were given ration 1 for the first eleven weeks when ration 2 was substituted and fed until the pullets were removed to the laying house. At maturity all pullets were leg-banded and removed to a 20 x 20 laying house and given the Standard A. and M. laying mash. Trap nest records and other information are being secured for a continuation of the study.

Table 67. Ration No. 1. Fed from 1 to 12 weeks of age.

Ingredient	Lot 1 parts	Lot 2 parts	Lot 3 parts	Lot 4 parts	Lot 5 parts	Lot 6 parts
Wheat bran	0	0	0	0	0	27
Yellow corn meal	53	53	53	53	53	27
Wheat shorts	23	23	23	23	23	27
Meat scraps	6	6	6	6	6	3
Cottonseed meal	6	6	6	6	6	3
Dried milk	6	6	6	6	6	3
Mineral mixture	6	6	6	6	6	3
Oat hulls	0	3	6	10	15	0
Alfalfa meal	0	0	0	0	0	7
Alfalfa stem meal	0	3	6	10	15	0
Protein mixture	0	2	4	7	10	0
Percent protein	16.42	16.49	16.35	15.81	16.44	16.40
Percent fiber	3.84	5.15	6.34	8.75	10.29	7.30

Note: Lot 6 was fed the Standard A. and M. chick ration. The protein mixture was composed of equal parts of cottonseed meal, dried milk, and meat scraps.

Reference: 1926-1930 Report of Oklahoma Agricultural Experiment Station, pages 151, 152, 153, 154, and 155, tables 64, 65, 66, 66a, and 67, Stillwater, Oklahoma.

Cross-Breeding for Broiler Production—Arkansas

Conducted by: Arkansas Agricultural Experiment Station.

Conducted at: Fayetteville, Arkansas.

Period: 1937-1939.

Purpose: To compare cross-breeds with pure breeds for broiler production.

Procedure and conditions: This study covers a period of 3 years in which a number of crosses were compared with pure breeds. The cross used in the study was shown in table 69. Each repeat cross was made within the same strain and was used the preceding year. Table 70 shows the rations used each year.

The chickens were weighed at weekly intervals. The weights for different groups are shown on 4, 8, and 12 weeks. The results of the test are shown in table 71.

Table 68. Fiber in rations for chicks.

Average weight of chick in pounds.		Fiber in rations for chicks.											
Date	Age in weeks	Lot 1		Lot 2		Lot 3		Lot 4		Lot 5		Lot 6	
2-12-30	Day old	.0740		.0727		.0730		.0740		.0749		.0730	
3-13-30	4	.4030		.3876		.4281		.4126		.3720		.3451	
4-10-30	8	1.0550		.9760		.9750		.9940		.9460		.8490	
5- 8-30	12	1.7340		1.7550		1.8530		1.8350		1.6910		1.5870	
		White Leg.	R. I. Red	White Leg.	R. I. Red	White Leg.	R. I. Red	White Leg.	R. I. Red	White Leg.	R. I. Red	White Leg.	R. I. Red
6- 5-30	16	2.089	2.808	2.233	2.692	2.277	2.883	2.238	2.83	2.107	2.69	2.042	2.557
7- 3-30	20	2.416	3.38	2.463	3.230	2.600	3.427	2.528	3.18	2.392	2.13	2.348	3.016
7-17-30	22	2.56	3.46	2.61	3.31	2.61	3.53	2.66	3.33	2.56	3.28	2.41	3.10
Mortality record—100 chicks per lot													
Period		No. live	Percent mort.	No. live	Percent mort.	No. live	Percent mort.	No. live	Percent mort.	No. live	Percent mort.	No. live	Percent mort.
Weeks													
1st—4th		87	13	94	6	86	14	97	3	100	0	99	1
5th—8th		86	1	89	5	84	2	94	3	99	1	97	2
9th—12th		86	0	89	0	82	0	94	0	97	2	96	1
13th—16th		85	1	89	0	82	0	94	0	95	2	95	1
17th—21st		84	1	88	1	80	2	94	0	0	0	94	1
Total		84	16%	88	12%	80	20%	94	6%	95	5%	94	6%

Table 69. The pure breeds and crosses, and the years studied.

Rhode Island Red	1937	1938	1939
White Wyandotte	1937	1938	1939
Rhode Island Red female x White Wyandotte male	1937	1938	1939
White Wyandotte female x Rhode Island Red male	—	1938	—
White Leghorn	1937	1938	1939
White Leghorn female x Dark Cornish male	1937	1938	—
White Leghorn female x White Wyandotte male	—	1938	—
White Rock	1937	1938	1939
Barred Rock	1937	1938	—
Barred Rock female x White Rock male	1937	1938	—
White Rock female x White Wyandotte male	1937	1938	—
White Leghorn female x Black Australorp male	—	—	1939
Rhode Island White	—	—	1939
Rhode Island White female x White Wyandotte male	—	—	1939
White Minorca	—	—	1939
White Minorca female x White Wyandotte male	—	—	1939
White Wyandotte female x White Australorp male	—	—	1939
(Rhode Island Red female x White Wyandotte male) female x White Rock male	—	—	1939

Table 70. Rations used during test.

	1937 and 1938 percent	1939 percent
Yellow corn meal	45.0	32.0
Wheat shorts (gray)	20.0	12.0
Wheat bran (mill run)	12.0	10.0
Rice bran	.0	12.0
Pulverized oatmeal	5.0	10.0
Meat scrap (50 percent protein)	6.0	8.0
Dried buttermilk	6.0	.0
Dried skimmilk	.0	8.0
Alfalfa leaf meal	3.5	5.0
Pulverized oystershell	1.0	1.5
Salt	.5	.5
Cod-liver oil	1.0	1.0

Table 71. Average weekly weights of birds within breeds and crosses between breeds—Arkansas, 1937-1939.

	No. birds at start	4th week		8th week		12th week	
		No. birds	Weight lbs.	No. birds	Weight lbs.	No. birds	Weight lbs.
Rhode Island Red	244	243	.38	241	1.18	229	2.18
White Wyandotte	190	178	.39	170	1.29	161	2.48
Rhode Island female x White Wyandotte male	316	313	.43	312	1.41	307	2.75
White Wyandotte female x Rhode Island male	66	64	.35	63	1.10	62	2.27
White Leghorn	295	288	.44	286	1.20	273	2.17
White Leghorn female x Dark Cornish	198	191	.36	191	1.14	182	2.21
White Leghorn female x White Wyandotte	56	55	.42	55	1.22	52	2.32
White Leghorn female x Black Australorp male	115	115	.42	114	1.26	110	2.21
Rhode Island White female x White Wyandotte	153	152	.45	147	1.26	138	2.24
Rhode Island White	100	98	.42	96	1.19	84	2.19
(Rhode Island Red female x White Wyandotte male) female x White Rock male	52	52	.45	49	1.34	46	2.35
White Rock	189	176	.35	171	1.18	155	2.23
White Rock female x White Wyandotte male	92	90	.36	89	1.27	87	2.43
Barred Rock female x White Rock male	184	181	.40	180	1.21	176	2.30
Barred Rock	152	150	.38	143	1.15	134	2.13
White Minorca	68	66	.40	63	1.10	60	1.91
White Minorca female x White Wyandotte male	52	41	.35	39	1.07	34	1.94
White Wyandotte female x White Australorp male	56	56	.43	55	1.42	51	2.41

Reference: Arkansas Agricultural Experiment Station Bulletin 411, "Cross-breeding for Broiler Production," pages 3, 4, 8, 9, and 10, table 1, Fayetteville, Arkansas, June 1941.

Comparison of Standard Breeds and Cross Breeds in Meat Production

Conducted by: New Jersey Agricultural Experiment Station.

Conducted at: New Brunswick, New Jersey.

Period: 12 weeks—chicks hatched March 4, 1937.

Purpose: The experimental work was set up with the following point in mind: To obtain information on the effect of crossing standard breeds on viability, rate of growth and efficiency of feed consumption.

Procedure and conditions: Pedigreed hatching eggs were obtained from two pens of B. P. Rocks, two of R. I. Reds, and two of R. I. Red males x B. P. Rock females. The two R. I. Red males which headed the crossbred pens were selected on the basis of having the greatest number of full sisters in the standard R. I. Red pens. The B. P. Rocks used in these experiments came from the station strain, which may be characterized as typically production bred, and the R. I. Reds came from an exhibition strain characterized by low hatchability and poor fecundity. In order to secure as large a number as possible of chicks of the same age, hatching eggs were collected from 30 days previous to incubation. Chicks were hatched on March 4, 1937, as follows: 72 Rhode Island Reds, 238 Barred Plymouth Rocks, and 243 hybrids.

The chicks were brooded under electric hovers, allowed free access to grassy yards during the entire growing period, and the sexes were separated at 10 weeks of age. The following ration was fed:

Mash Ration

20 pounds yellow corn meal
 20 pound wheat bran
 20 pounds flour middlings
 20 pounds pulverized oats
 10 pounds meat scrap
 5 pounds dried skimmilk
 5 pounds alfalfa leaf meal
 2 pounds limestone flour
 $\frac{1}{4}$ pound fortified cod-liver oil
 $\frac{1}{2}$ pound salt

Grain Ration

100 pounds cracked yellow corn
 150 pounds wheat

Table 72. Feed consumption, body weight, and mortality of standard-bred and crossbred chicks.

Age wks.	Rhode Island Reds			Barred Plymouth Rocks			Red Males x Rock Females		
	Lbs. feed per 100 chicks	Weight of chick	Percent mortality	Lbs. feed per 100 chicks	Weight of chick	Percent mortality	Lbs. feed per 100 chicks	Weight of chick	Percent mortality
2	19	.16	—	22	.17	—	31	.17	—
4	81	.37	3.5	85	.40	6.5	98	.42	1.6
6	206	.72	—	211	.79	—	259	.99	—
8	407	1.16	1.4	373	1.04	2.4	471	1.23	1.2
10	710	1.60	—	661	1.75	—	717	1.94	—
12	950	2.20	1.4	945	2.50	.9	996	2.67	0
Total	950	—	6.3	945	—	9.8	996	—	2.8

Reference: New Jersey Agricultural Experiment Station Bulletin 656, "Meat Production in Chickens," pages 3, 4, 7, and 8, tables 1, 2, 3, December 1938, New Brunswick, New Jersey.

Marketing

Marketing is one of the most vital factors in a broiler business and in this connection there are certain questions dealing with broiler marketing that should receive consideration.

1. When is the best time to market broilers?

A tabulation of monthly broiler prices for three available markets, New Orleans (table 74), New York (table 75), and Chicago (table 76), for a 10-year period, 1930-39, and a graph of average monthly prices is presented for consideration on this question. These tabulations should be helpful in determining the best time to market broilers. The monthly prices should be kept to date. This information may be secured from several of the daily papers. The above mentioned tabulations were secured from the New Orleans Times-Picayune.

Table 73. Suggested form for figuring returns using different methods of marketing.

Items of expense	Ship by express sell through commission dealers	Ship by freight sell through commission dealers	Ship by truck sell through commission dealers	Sell to poultry truckers	Sell to local poultry dealer	Sell to local feed dealer	Sell to custom trade	Other ways	Other ways
Transportation	x*								
Shrinkage	x								
Commission	x								
Total cost of marketing									
Price quoted									
Returns above cost of marketing									

*The checked items of expense are the usual expenses with this method of marketing. This comparison should be made with other methods.

2. Where is the best place to market broilers?

The tabulations mentioned above give monthly prices on three available markets, New Orleans, New York and Chicago, for 12 years, 1930-1941. To decide between these markets or other markets the cost of transportation, time required to get to market, reliability of person or concern to whom broilers are shipped and cost of selling should be determined. In presenting the broiler prices of these markets it does not mean that these are the only markets available. There are available markets in Mississippi for a limited number of broilers. All available markets favorably located should be considered before a selection is made.

Table 74. New Orleans market prices for broilers.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1930	26.6	26.9	34.5	29.3	36.3	30.6	27.0	22.3	25.3	23.3	21.3	17.6
1931	21.1	30.6	33.0	34.5	31.7	28.0	24.0	22.7	20.2	18.7	18.4	18.1
1932	17.1	19.2	21.0	24.0	21.5	16.2	15.3	14.0	14.7	13.3	13.0	12.3
1933	12.8	16.1	18.0	20.0	21.5	18.0	15.0	12.7	13.0	12.7	11.5	11.2
1934	12.2	21.5	22.7	24.4	23.2	21.7	19.3	16.4	16.6	14.9	14.9	15.4
1935	16.2	22.1	24.1	24.1	24.0	21.6	18.4	16.9	18.7	18.9	18.9	18.7
1936	20.0	21.3	23.1	25.0	24.5	21.8	19.3	16.1	17.5	16.5	15.6	16.4
1937	20.7	21.8	23.9	24.8	24.8	25.5	22.4	22.7	22.7	22.0	22.0	21.0
1938	22.7	22.2	23.0	25.5	23.0	20.6	18.0	17.0	18.0	17.0	16.5	16.3
1939	16.8	17.8	20.0	20.7	19.2	21.5	17.8	14.5	17.3	15.5	15.3	15.0
1940	16.0	17.1	18.5	19.5	21.7	19.7	17.0	16.3	16.6	15.9	16.5	15.9
1941	16.3	16.9	19.1	20.9	19.5	19.1	20.4	19.9	20.3	18.5	19.6	21.4
1942	21.5											
Av.*	18.2	21.1	23.4	24.5	24.4	22.0	19.4	17.6	18.4	17.2	16.9	16.6

*12-year average, 1930-1941.

Table 75. New York market prices for broilers.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1930	31.5	35.0	42.3	43.0	40.0	42.0	34.0	31.5	31.0	25.0	33.3	42.3
1931	35.5	38.0	37.0	36.3	37.0	34.2	33.3	29.7	27.0	27.5	24.5	21.2
1932	20.3	21.3	27.0	25.0	25.5	22.6	22.2	19.0	20.0	19.0	20.0	17.0
1933	18.0	20.6	23.0	25.0	22.5	21.3	22.0	19.2	18.6	17.2	16.3	15.7
1934	21.5	23.5	24.7	23.0	23.0	25.8	24.7	22.7	23.0	19.7	21.0	22.0
1935	19.7	19.0	22.0	20.0	26.0	24.7	21.0	22.5	23.0	24.0	22.7	23.0
1936	25.0	24.0	24.0	27.6	21.5	25.5	23.8	23.0	23.8	22.0	18.0	18.2
1937	21.0	22.3	23.6	24.0	24.5	22.8	23.5	28.6	28.5	31.0	29.6	27.3
1938	23.0	22.2	22.7	24.7	23.5	22.7	23.0	22.0	21.5	21.6	20.5	20.2
1939	20.5	21.2	20.5	20.5	21.0	22.0	21.5	21.4	20.5	19.0	18.4	17.0
1940	17.7	19.9	20.8	19.8	21.8	21.0	18.2	18.0	17.8	17.3	17.2	19.1
1941	19.6	21.0	21.0	20.3	19.8	19.8	20.0	19.9	20.7	20.3	19.4	20.0
1942	22.0											
Av.*	22.7	24.0	25.7	25.7	25.5	25.3	23.9	23.1	22.9	21.9	21.7	21.9

*12-year average, 1930-1941.

Table 76. Chicago market prices for broilers.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1930	29.2	31.5	39.5	39.5	38.0	23.2	22.0	21.2	22.1	20.2	18.2	20.2
1931	23.0	25.4	33.7	38.2	31.2	23.0	24.7	20.2	17.0	15.0	15.8	15.7
1932	16.0	19.7	22.0	20.5	20.5	17.2	14.7	12.9	14.6	12.2	11.3	12.7
1933	12.3	13.3	12.2	13.3	14.0	14.7	10.5	11.8	10.0	8.0	7.7	8.5
1934	14.7	14.5	17.5	20.5	23.0	24.5	21.5	19.2	17.9	17.4	16.0	17.5
1935	20.5	23.2	24.7	24.8	23.9	20.7	19.2	20.4	19.6	19.2	15.9	16.5
1936	21.2	18.0	23.9	26.3	26.0	25.0	21.5	17.6	20.7	16.0	16.7	16.5
1937	21.7	23.8	25.9	24.6	25.0	19.6	21.9	23.2	24.2	25.5	26.0	26.0
1938	20.7	20.0	20.5	23.0	21.2	18.4	17.3	16.5	17.1	17.0	18.0	16.3
1939	16.0	18.2	21.3	19.5	19.4	17.3	17.0	14.7	16.0	15.8	15.3	15.7
1940	16.3	17.9	19.4	20.1	22.3	17.4	16.8	16.3	16.7	17.5	18.4	16.8
1941	17.7	18.2	19.9	21.3	19.2	18.3	19.1	18.8	18.9	19.2	18.8	18.6
1942	18.1											
Av.*	19.1	20.3	23.3	24.3	23.6	19.9	18.8	17.7	17.9	16.9	16.5	16.7

*12-year average, 1930-1941.

Reference: Daily Times-Picayune, New Orleans, Louisiana.

3. How should broilers be marketed?

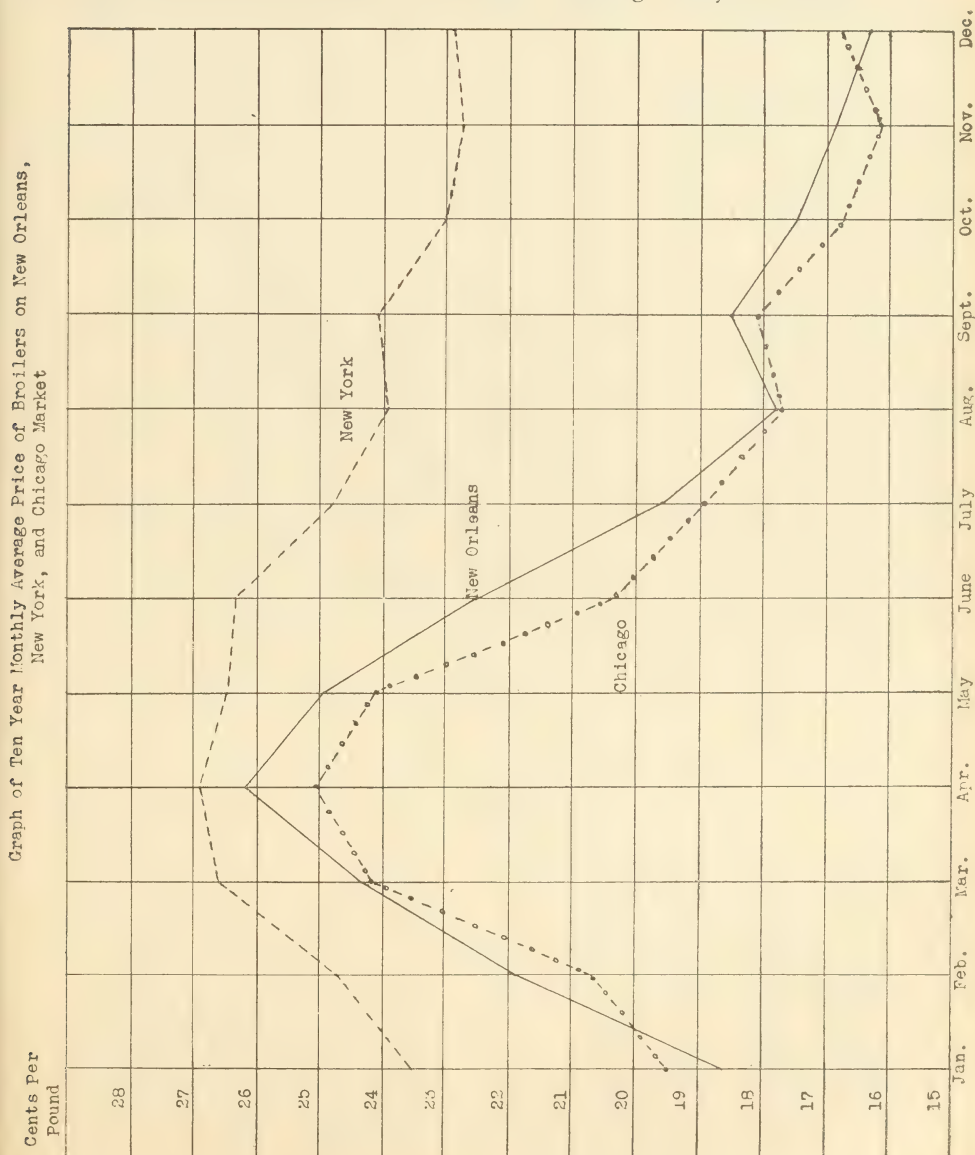
There are several ways of marketing broilers. An attempt is made to point out some of the ways.

a. Shipping by express and selling through commission dealers.

b. Shipping by freight and selling through commission dealers.

- c. Pooling broilers and shipping by truck and selling through commission dealers.
- d. Selling to poultry truckers from New Orleans and other markets.
- e. Selling to local poultry dealers.
- f. Selling to local dealers (This method is practiced in the Jackson Area).
- g. Selling to custom trade (hotels, restaurants, etc.).

The broiler producer should investigate the different ways of marketing to determine the highest net returns before selecting a way to market.



Diseases and Parasites

Diseases and parasites very often cause the broiler producer a great deal of trouble and expense. The most careful producer will have trouble with some disease or parasite. Every precaution should be exercised to prevent disease and parasite infection, but in many cases the precautions fail and it is necessary that the producer know how to determine the trouble and how the trouble should be treated.

The broiler producer should be careful in purchasing chicks, buying from a reliable hatchery that supplies disease-free chicks. By doing this a great deal of trouble may be avoided.

Suggestive Questions

1. What are the most common diseases of broilers?
2. What causes these diseases?
3. How are they spread?
4. How may the diseases be controlled?
5. What are parasites?
6. What parasites attack chickens?
7. How do parasites spread?
8. How may parasites be controlled?

Pullorum Disease of Chicks (Bacillary White Diarrhea)

Pullorum disease is a highly fatal and contagious disease of young chicks. A large percentage of losses from diseases in chicks under three weeks of age appears to be traceable to this cause. Its ravages have rendered many flocks unprofitable.

The disease is one of the few affecting adult fowls that may be transmitted directly through the egg to the newly hatched chick. It is rare that mature stock infected with the disease show any symptoms, yet when infected hens are killed and the body cavity opened, abnormal or diseased yolks are found. Infected parent stock and contaminated incubators and brooders are largely responsible for the presence of the disease in young chicks.

The specific cause of pullorum disease is a microscopic germ known as *Salmonella pullorum*. This organism gains entrance to the chick through the digestive tract with contaminated feed or water, or, as indicated above, it may have been in the egg from which the chick was hatched. The germ is found in the blood, in the unabsorbed yolk, and in the internal organs of baby chicks following death from the disease. The droppings of affected chicks, as well as infertile or unhatched eggs from infected breeding fowls, often contain *Salmonella pullora* in large numbers.

Conditions which tend to weaken the vitality of baby chicks are regarded as important factors in susceptibility to the disease. Proper brooding and handling of chicks from infected stock or of those exposed to the disease are regarded as helpful in reducing losses.

Symptoms in baby chicks. Chicks are most susceptible to the disease before they are five days old, though symptoms may not be observed for several days after exposure. Heavy losses in chicks under three weeks of age are often traceable to an acute type of the disease. Affected chicks are weak and unsteady in standing and walking. The feathers are ruffled, the eyes closed, and the wings drooping. Diarrhea usually develops with a "pasting

up behind" and death follows in a few hours. Chicks suffering from an acute type of the disease, however, may die before symptoms of diarrhea appear. The absence of diarrhea, therefore, cannot be regarded as definite evidence of the absence of pullorum disease.

An accurate diagnosis of pullorum disease can be made only by laboratory examination. A flock owner who suspects the presence of the disease should send typically affected live chicks to a properly equipped laboratory for examination.

Surviving chicks should not be used as breeders: Chicks that suffer a temporary setback from a mild attack of pullorum disease, followed by apparent recovery, develop a low-grade, chronic type of the disease in the yolks of ovaries and, as mature birds pass on the infection to young chicks in subsequent hatching seasons. **Therefore, such chicks should not be kept for breeders.**

How the disease spreads. The part which mature infected fowls play in transmitting the disease to baby chicks through the egg has been established in experimental tests and confirmed in outbreaks of the disease in farm flocks. In fact repeated heavy losses of baby chicks unexplained by other causes are often the first suggestion of the disease in mature fowls.

Pullorum disease may thus be regarded as being transmitted through the egg to the chick, and from egg-infected chicks to healthy chicks through contaminated droppings in incubators, brooders, and water and feed containers. One chick infected with pullorum disease at hatching time is capable of contaminating incubators and spreading the disease to the entire brood.

While it is not definitely established that pullorum disease is commonly spread among adult hens through association with infected hens or by an infected male in breeding, it is possible that the rapid progress of the disease in some breeding flocks may be accounted for in this way.

Control of Pullorum disease. The control of pullorum disease depends largely upon two factors: first, the detection of infected breeding fowls by means of certain tests and their removal from the flock; second, the sanitary protection of healthy chicks against infection in incubators, brooder houses, and contaminated runways.

The greatest progress in freeing flocks from pullorum disease has been made by owners who have removed infected breeding stock and applied the fundamentals of chick sanitation. In healthy, vigorous flocks, properly managed, the complete extermination of the disease is possible. In fact, several clean flocks have been established and the amount of infection greatly reduced in other flocks in which pullorum disease was found.

It is to be expected that some flock owners will be more successful than others in stamping out this disease, yet anyone can reduce losses by adopting approved methods of sanitation and testing his flock regularly.

Tests for detecting the disease. The testing of flocks for pullorum disease is usually done in the late fall, after culling. The value of the tests in detecting infected breeding stock over one year of age is well established, although it must be acknowledged that no biological test is perfect and that repeated tests are more valuable than a single test. The tests for pullorum disease represent but one part of the control program. In order that they may give the best results, they should be applied by skilled persons.

Reference: Illinois Agricultural Extension Service Circular 432, "Pullorum

Disease of Chicks," pages 3, 4, and 6, March 1935, Urbana, Illinois.

Bronchitis

The chief symptom is gasping for breath. The disease spreads so rapidly that a few cases may be seen in a house in the morning and by night 75 to 90 percent of the birds may be affected. Not infrequently death will take place in from a few minutes to a few hours after first symptoms are noticed. The most typical post-mortem finding is the presence of clotted blood in the trachea which is apparently the reason for the difficult breathing. In the birds that die later in the outbreak, typical diphtheric membranes may be found in the trachea.

Treatment of mature fowls is of little avail, death usually taking place either before it can be administered or in spite of it. In baby chicks, placing in a tight compartment and applying medicated steam has seemingly been of some value. Water to which a teaspoonful of carbolic acid or oil of eucalyptus has been added can be boiled in the compartment. The steaming can be repeated at intervals of a few hours and apparently does bring some relief in the breathing, although of course it is merely palliative. Some poultrymen have sprayed the baby chicks with a harmless antiseptic. The steaming, however, seems to be fully as effective. When the disease breaks in a large flock of mature fowls, it spreads so rapidly and the mortality is so high that vigorous measures must be instituted at once or the loss will be great. To stop the inroads it is better to slaughter all the mature fowls in a given house and sell those for meat that have not yet shown symptoms. The house can then be thoroughly disinfected and allowed to remain vacant for at least a month before putting other fowls into it. In a large establishment this may be repeated in each house that becomes affected. Special care must be given that attendants ministering to the sick fowls do not go into the houses where the disease has not yet developed.

Roup

Roup is a highly contagious disease affecting especially the mucous membranes of the upper air passages and the eyes. It usually affects mature birds or at least those that are half grown or over. It rarely attacks chicks under two months of age.

The cause is probably a filterable virus which is introduced in many cases by the purchase of new chickens or by bringing in birds that have been sent to shows. There are also healthy birds that have passed through a previous outbreak and are still carrying the virus. These, known as "carriers," continue the disease in a flock from year to year. Undoubtedly, the usual devitalizing influences are a considerable factor. These are exposure to cold, overcrowding, lack of ventilation, improper diet, etc. The disease is more prevalent in the winter than in the summer but may be seen at any time of the year.

The early symptoms are watering from the eyes and nose accompanied by sneezing and coughing. Later the discharges become thicker and clog the nostrils and glue the eyelids together. The lids will not be swollen and as the nostrils are closed the bird breaths through its mouth, thus drying the tongue. At this time the bird droops, may refuse food, the feathers are ruffled and diarrhea may supervene. Still later the cavity just below the eye fills with an exudate that then becomes cheesy and putrid and causes a swelling of the face at this point. This swelling is particularly characteristic of roup.

The birds may die at any time during the course of the disease, the younger ones dying early and the stronger or older keeping up at times for several days and even recovering in many instances. The disease may spread rapidly through the flock with a high percentage of mortality.

The proper handling of a flock affected with roup requires decisive and energetic action. It is usually better to destroy all sick birds but if treatment is to be attempted, the sick should be isolated and as fast as others are taken sick they should be removed. If only the birds in one pen are affected, precautions should be taken to see that the disease does not spread to the rest of the flock. The houses and pens should be cleaned thoroughly and disinfected at frequent intervals and special attention should be given to the drinking vessels. Potassium permanganate or a pinch of chlorinated lime may be used in the drinking water.

Housing is recognized as a large factor in the development of roup. Damp, poorly ventilated, cold, and overcrowded houses must receive attention. Correction of the housing conditions will often in itself stop this disease.

If treatment is to be attempted the heads of the affected chickens may be dipped into a warm solution of any of the following:

Potassium permanganate—1 level teaspoonful to a pint of water.

Chlorinated lime—a pinch of the powder to a pint of water.

Hydrogen peroxide diluted 1 to 3.

If there is a bulging of the face that has been present for some days it may be incised with a sharp knife, after which the cavity may be washed out with any of the above solutions.

Prevention of roup by vaccination has been tried by many investigators. Some have used the virus of chicken pox, others have made the vaccine from the bacterium that causes chicken cholera and still others from a miscellaneous group of organisms associated with roup. While some excellent results have been reported, all that can be said at this time is that vaccination against this disease is still in the experimental stage and if used at all should be used with this understanding.

Chicken Pox

The disease is characterized by warty nodules in the comb and wattles and other unfeathered portions of the head. It is largely confined to older birds, is not so common in Colorado as roup or diphtheria and is generally less fatal. There are occasional outbreaks where the mortality is quite high. It seems to have been definitely proved that the cause is a micro-organism that is too small to be seen even by the microscope. Affected birds live several days, frequently recover, especially if properly treated. At times the inflammatory disturbance of the skin spreads to the mucous membranes of the mouth, forming there false yellow membranes simulating diphtheria.

Treatment consists of painting the nodules and the false membranes with tincture of iodine. In the milder cases the growths fall off; the birds recover. All sick birds should be isolated as soon as found and either treated or destroyed. House and pens should be cleaned and disinfected.

The California Experiment Station prepared a vaccine from the nodular growths that has been quite successful in preventing the disease. At first the vaccine was administered subcutaneously but more recently it has been shown to be more effective when placed in a scratch on the skin or applied to the point where a few feathers have been plucked. The scratch method seems

preferable. Vaccination is to be recommended in the presence of this disease.

Reference: Colorado Agricultural Extension Bulletin 310A, "Diseases of Poultry," pages 18, 19, 20, 21, 22, 23, 24, and 25, January 1932, Fort Collins; Colorado.

Roundworms

The roundworms of the common fowls are largely of two varieties, those found in the intestinal tract in front of the cecum (*Ascaridia lineata*), and those found in the cecum (*Heterakia gallinae*). The intestinal roundworm is from 1 to 3 inches in length and may be present in such numbers as to almost fill the gut. The cecum worm is much smaller, seldom attaining more than one-half inch in length and may be found in enormous numbers in that organ. These roundworms produce emaciation and weakness but seldom cause death. Because of the interference with nutrition, however, it is best to keep birds free from them.

The most commonly used treatment and the easiest to administer is carried out by adding tobacco dust to the mash in the proportion of 2 percent (2 pounds of tobacco dust to 100 pounds of mash) and keep this before the birds for from 1 to 2 weeks. This method of treatment when used at occasional intervals will keep down the worms but may not be as effective in individual birds as the single dose method. Some recommend nicotine sulphate but this is so poisonous that unless it is mixed with some bland substance like Fuller's earth, it will destroy the fowls. It is highly effective but should be used in a form put up commercially so that dosage and buffer can be regulated. The United States Bureau of Animal Industry recommends oil of chenopodium given by rectal injection when mixed with cottonseed oil, more especially for the cecum worm. The dose is one-tenth cubic centimeter of oil of chenopodium in 5 cubic centimeters of cottonseed oil for half-grown birds. By the use of a rubber syringe it is contended that this can be injected just as easily and more efficiently than when given by the mouth.

Cleanliness means much in the prevention of worms since worm eggs are continually being passed out with the droppings, and unless these are cleaned up at frequent intervals a continuous cycle will be established which will keep the chickens constantly infested. Ordinary disinfectants are of little value in the destruction of worm eggs. Their entire removal from the premises is essential if the cycle is to be broken.

Tapeworms

There are many species of tapeworms infesting the fowls, running in size from those that can be observed only by the aid of the microscope to several inches in length. Several species may be found in the same bird at the same time. These worms are easily differentiated from the roundworms because they are jointed and flat. In young birds they are even more serious than the roundworms, not infrequently causing death. Hall of the United States Bureau of Animal Industry has found that the best medical treatment is powdered kamala. He recommends the administration of 1 gram (15 grains) by the mouth either in a capsule or in the form of a tablet. Birds will swallow these quite readily when placed in the back of the mouth. This dosage is for mature fowls. Where young birds are treated, the dosage may be cut in half or even more. Kamala will destroy certain of the weak chickens and particularly any that may be suffering from deficiency disease or roup.

Tapeworms pass a part of their life cycle in insects of various kinds, particularly the common housefly. Consequently, it is better to collect the droppings at frequent intervals and treat them so that they will not be infested with flies. All measures tending to keep down the flies will also tend to break the cycle of the tapeworm. Avoid feeding liquid milk which draws flies. Milk should be allowed to clabber and drop before feeding. The addition of powdered borax to manure piles is an effective means of reducing the number of flies.

Lice

There are many species of lice infesting poultry. These insects rarely cause death in themselves but in birds depleted by other diseases they bring about much irritation and loss of flesh. Most lice are of sufficient size so that they are easily seen on examination under the wing or inside the thigh.

The treatment as recommended by the U. S. Department of Agriculture consists in the application of sodium flouride either as a dusting powder or as a dip. Sodium fluoride can be purchased at most any drug store or poultry supply house. It may be applied directly by putting a pinch deeply into the feathers at numerous places over the body of the bird. This is commonly known as the pinch method. The powder is gradually dispersed and may be expected to kill the lice within 4 or 5 days. The dipping method is more rapid in its action and possibly more effective, but it can only be used in favorable weather. The dip is made up by adding 1 ounce of sodium fluoride to 1 gallon of warm water and the hens are thoroughly dipped so that all portions of the body are reached. This method usually results in the destruction of the lice within 24 hours but where infestation is severe it is better to repeat it in 1 week.

Mites

Common red mites (*Dermanyssus gallinae*) of the fowl are night prowlers, usually leaving the birds before morning and spending the day hidden away from the light in the cracks under the roosts. For this reason they are easily attacked. By way of prevention it is better to have the roosts set in slots so that they can be readily removed at frequent intervals. The mites can then be sprayed directly with some injurious oil. Waste cylinder oil from automobiles, to which has been added a pint of kerosene will kill the mites but it may require frequent applications because of its thinner body. Crude petroleum and creosote are also effective.

Coccidiosis

This is a parasitic disease of chickens and other fowls which is very wide spread and highly destructive, especially to half-grown chickens. It is most fatal in chicks from 2 to 10 weeks of age. In older birds, particularly during the first winter, it sometimes causes leg weakness and finally death. The cause is a one celled animal of microscopic size that is present in large numbers in the droppings of affected birds. The parasite is spread by contamination of the drinking water and the feed, by means of the droppings of the diseased individuals.

The younger chickens show a bloody diarrhea, great weakness, and die in from 1 to 5 days. The older birds lose weight, the comb and wattles become pale and finally the birds become unable to stand on their legs. They usually die only after several days or weeks.

Since it has been shown that the parasites are not capable of affecting

other birds for 2 or 3 days after they are discharged, daily cleaning of the brooders, pens and houses will go far toward eliminating the disease. Where it is possible, the diseased birds should be destroyed and the well ones moved to entirely new ground. Where this is not possible, daily cleaning with occasional disinfection will help materially. Among these has been bichloride of mercury (corrosive sublimate) in the proportion of a $7\frac{1}{2}$ grain tablet to a gallon of water and powdered crude catechu, one-third teaspoon to the gallon of water.

The California station seems to have made the most progress in handling the malady by the addition of large quantities of milk to the ration. They showed that the organism did not develop in the intestines if a certain acidity could be maintained. This was best brought about by the addition of milk, either in the form of fresh milk, dried milk or dried buttermilk. It was shown to be essential, however, that milk comprise at least 40 percent of the ration. If it is to be used as whole milk, no water should be given the birds as otherwise they will not take sufficient quantity. They recommend the following ration where dried skim milk is to be used.

Dry skim milk	40 pounds
Wheat bran	10 pounds
Yellow corn meal	30 pounds
Ground barley	20 pounds

The milk should be continued for 2 or 3 weeks after the outbreak.

It seems that we must look upon coccidia as being always present to some degree in our mature fowls and in the soil of our poultry yards. The real problem is then, by better sanitation, to hold down the number of coccidia ingested until the young birds have developed a resistance to their presence.

Reference: Colorado Extension Service Bulletin 310A, "Disease of Poultry," pages 34, 35, 36, and 37, January 1932, Fort Collins, Colorado.

Beef Calf Production in Mississippi

Under Conditions of Minimum
Investments in Pastures
and Breeding Herds

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MISSISSIPPI STATE COLLEGE
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Beef Calf Production in Mississippi

By **RAY H. MEANS, A. E. CULLISON,**
E. B. FERRIS, and S. P. CROCKETT

The increased production of beef cattle has been recognized as one of the great agricultural possibilities of Mississippi.

Much of the land area of the state is unsuitable for profitable row-crop production—some of it having slopes so steep that cultivation invites erosion, some of it already badly eroded, some of it in lowlands too subject to overflow for safe crop production, and some of it so lacking in natural fertility as to require the annual application of very large amounts of commercial fertilizer. There is a definite need for the profitable utilization of such land on every farm as may not be suitable for profitable row-crop culture, and pastures and livestock seems to answer the problem on numerous Mississippi farms.

In addition to the need for a means of economically utilizing non-productive or unprofitable acres, the need for cash income in addition to that from cotton is pressing. The increased production of livestock seems to offer an answer to that and other problems on numerous Mississippi farms—more livestock to serve as a cash market for grain and forage produced, to supply fertility to the land, to profitably utilize pasturage, and to add materially to the family food supply and to the cash income of the farm.

This report is concerned with a particularized phase of livestock production: the production of beef calves to be sold at weaning. There are numerous other phases of livestock production, including other phases of beef production, dairying, poultry production, sheep and wool production, and swine production. The choice between them is an individual matter for each farm, and the determination of which one or which combination of

livestock enterprises may be best for any particular farm, must be made by each farmer on the basis of such factors as labor supply, capital, land and feed available for the livestock enterprise, markets, and the farmer's personal preference and liking. The purpose of this report is not so much to "sell" beef production above other livestock enterprises, as to indicate the financial possibilities of beef production on large numbers of Mississippi farms.

Fluctuating Livestock Production

Livestock production has steadily and considerably increased in Mississippi during recent years. As late as 1930, the number of cattle on Mississippi farms was only 841,067; at the beginning of 1941 there were 1,139,660. This represents an increase of 35.5 percent in cattle population. Due in large part to the AAA program, there has been an increase in the combined acreage of grain and roughages. A portion of the consequent increase in the production of grain and roughages has been used to supply deficiencies which have long existed on Mississippi farms; a part, perhaps the major part, has been used as feed for the increased livestock population.

Livestock numbers in Mississippi have varied from time to time over a long period of years. There have been periods when livestock production was increased, followed by periods when livestock production was diminished. Various causes have been suggested for these variations, the competition of high-priced cotton being a favored one.

It seems logical to assume that Mississippi farmers have selected and pushed those agricultural enterprises best suited to their production facilities, and yielding, or promising to yield, the most profit.

Whatever the cause of the fluctuation in livestock population—whether the competition of high-priced cotton or the disappointing financial returns too often received from livestock, or whether too much was expected of livestock—the basic need of more livestock on Mississippi farms is and has been acute, and is further emphasized by war needs of the present and an undetermined future period.

It appears, also, that considerable numbers of farmers in favored areas have profited by livestock production, and that smaller numbers of farmers having exceptional facilities in less favored areas have also profited from livestock production. That is, livestock production is easiest in the natural grass- and clover-growing areas, such as the prairies and limited parts of the brown loam area; but farmers have successfully produced livestock in other areas where they were especially interested, or where markets were better than average, or where personal interest and love of livestock were combined with adequate financial resources.

Livestock Opportunities in Mississippi

Undoubtedly there have been failures and disappointments in livestock production in all areas of Mississippi. Undoubtedly, also, there have been successes. In view of the successful and large-scale production of livestock in relatively unproductive areas of the United States—namely, in the West, where as much as 40 acres of land is required for each cow and her calf—there appears no valid reason why beef cattle cannot profitably be produced in Mississippi, where pasture herbage grows much more profusely, even under unimproved conditions.

It has been the experience of the Mississippi Agricultural Experiment Station over a period of approximately 50 years that beef cattle can be profitably produced (prevailing prices permitting) when-

ever certain minimum requirements are met. These minimum requirements are low, and are within the reach of many thousands of farmers. They are:

1. **A minimum-for-efficiency investment in land for pasture** which is adequately fenced and so prepared that mowing or clipping may be done at least twice a year. The establishment of desirable pasture grasses and legumes by seeding or sodding is highly desirable but not absolutely necessary for profit.

2. **A minimum-for-efficiency investment in the breeding herd.** Pure-bred or high-grade beef cows and registered beef bulls are desirable but not absolutely necessary for profit. Good results have been had from south Mississippi native cows and registered beef bulls.

In view of the urgent need for the increased production of meat to supply war requirements, and in view of the continuing need for better balanced agricultural production in Mississippi, it is believed that recent experience by the Mississippi Station may be of value and real service to large numbers of state farmers who wish to begin livestock production but who desire some information as to what the outcome may be.

Observations by Mississippi Station

In the early spring of 1941, the Station purchased 80 south Mississippi native cows and divided them into 4 lots of 20 cows, each headed by a registered Hereford bull, for use in a minerals experiment. One lot was placed on the long-established, minerals-rich pastures of the Station at State College, and three lots were placed on minerals-deficient pastures in a "flatwoods" land-use experimental area provided by the Federal government. Calves produced in 1942 were marketed in Montgomery, Alabama.

Also in the early spring of 1941, 30 south Mississippi native cows and a registered Aberdeen Angus bull were purchased for the Holly Springs Branch Ex-

periment Station, principally to utilize pasture made unfit for milk production because of wild onion infestation. Calves produced in 1942 were marketed in Memphis, Tennessee.

Fifty south Mississippi native cows and a registered Hereford bull were purchased for the Natchez Branch Experiment Station, for use as a foundation herd and for miscellaneous livestock and breeding experiments; 25 of these cows were purchased in January and 25 in September, 1940. A registered Hereford and a registered Polled Hereford bull were provided. Calves produced in 1942 were marketed in a community auction sale at Natchez, similar to community auction sales held in numerous communities in Mississippi.

In the early spring of 1942, 180 native south Mississippi cows were purchased for

the use of the Experiment Station in a land-utilization project on a portion of a 4000-acre tract supplied by the Soil Conservation Service of the Federal government. These cows were range-bred at the time of purchase, and produced native calves in 1942, but were bred to registered bulls for the 1943 calf crop. The 1942 calf crop, all natives and showing little or no admixture either of dairy or beef breeding, was marketed in St. Louis, Missouri.

Variety of Circumstances in Test

Thus, all of the cows used were south Mississippi natives, and showed little or no admixture either of dairy or beef breeding. Most of them were horned, and while there was no uniformity of color, reds, whites, and mixtures of red and white, predominated. Sizes varied considerably, but on the average the south



Figure 1. This good pasture was brush land 2 years ago, abandoned from cultivation for 5 years or more. It was cleared of brush at moderate cost, with regular farm labor and equipment.

Mississippi native cows appeared somewhat larger than the grade Jersey cows prevalent in north Mississippi, and there was considerable increase in size after a year or more on good pasture. The native cows seemed to have a good flow of milk. Their calves, when sired by beef-type bulls, compared fairly well with calves from high grade beef cows in the Station herd at the State College.

The pastures used represent 4 separate soil types: prairie soils, flatwoods soils, thin-phase brown loam soil, and deep-phase brown loam soil. Treatments used in establishing these pastures varied from the bare minimum of mowing, to a schedule of recommended pasture practices: seeding, fertilizing, and mowing. The acreage grazed per cow varied quite widely. The calves were marketed on 4 separate markets, such as commonly used by car-lot livestock shippers in Mississippi.

The data presented are not given on a cost-accounting basis, and the increases in value shown do not represent net profit. Interest on investment is not calculated, nor is the cost of labor and of feed used in wintering shown. The effort is to present details of a beef-calf producing program based on minimum-for-efficiency expenditures and such as can be carried into effect on many thousands of Mississippi farms.

Beef Calf Production at the Central Station, State College

The soils at State College include most of the typical prairie soils; the predominant soil in the Animal Husbandry department pasture, however, is Oktibbeha Clay. This is a somewhat plastic and infertile soil and is not often successfully used for row-crop production. However, it has proven to be an excellent soil for pastures.

Pastures Long Established

Establishment of pastures in the Oktibbeha area antedates the establishment of Mississippi State College. Col. W. B. Montgomery, member of the first Board of Trustees of State College, pioneered in dairy production and in the establishment of desirable grasses and clovers. During the past three-quarters of a century, desirable pasture plants have become more and more widely distributed throughout the prairie area of Oktibbeha County. Pastures have been more or less steadily developed throughout this period, especially during the more recent years. The experiment station pastures have been enlarged by land purchases, by clearing brush growth and terracing, and by mowing. Not a great deal of seeding has been thought necessary, and only a minimum amount of fertilization has been done.

The cattle included in this project were purchased for use in a minerals experiment in which one group was kept on this high mineral soil while the other groups were kept on soils deficient in lime and other minerals. Results of the minerals experiment will not be available for 3 years or more, but the production data thus far secured seems appropriate for use and are therefore made a part of this report.

In conformity with management practices in handling the native south Mississippi cattle used at Natchez, Holly Springs and the Land Use Area, the cattle at State College have been confined to the pastures since their arrival. No shelter has been provided, in summer or winter, the cattle finding protection in woodlands. Winter feed has consisted of hay cut from and stacked in the pastures as a part of the pasture clipping program. No other feed has been fed.

Native South Mississippi Cows

The State College cows were a part of the lot of 90 native south Mississippi

cows purchased in February 1941, and of 23 head originally scheduled for State College, 3 cows died shortly after arrival. The average cost delivered at State College was \$32 per head, or a total of \$736. A registered Hereford bull cost \$160, giving a total investment for 21 cows and one bull of \$896.

Only 5 calves were produced during 1941. These were sold for \$150. Two cows were disposed of as a result of positive reaction to Bangs disease, one in June 1941 for \$34.50; the other in December 1941 for \$40.00. A third cow died.

The 18 remaining cows produced 15 calves during 1942, or an 83.3 percent calf crop, which is usually considered about normal under good beef cattle management practices.

A summary of results, including a financial statement, is shown in table 1.

Nine steer calves were marketed on October 23, 1942, through Swift and Company at Montgomery, Alabama, at \$11 per 100 pounds live weight less 2 percent for shrinkage, the buyer paying transportation costs. The average weight of the steer calves was 439 pounds and the average selling price per head was \$46.86.

Six heifer calves, averaging 430 pounds, were kept for breeding purposes. The heifers were equal in quality to the steer calves and in all likelihood would have sold on the market for an equal price per pound. On this basis the average value per head was \$45.87.

150 Percent on Investment

Receipts from sales, accounted for above, plus the value of heifer calves retained for the breeding herd, gives a total of \$921.79. This is \$25.79 more than the original investment. On hand are 18 cows which are worth, on the basis of other cows sold, \$1169.60, and one Hereford bull worth more than \$160. Thus, the original investment of \$896 resulted in sales plus value of cattle on hand totaling \$2251.39, a total calculated increase of \$1355.39 or approximately 150 percent of the original investment in breeding stock.

Rainfall at State College and in the nearby Land Use Research Area was quite deficient during the 1942 grazing season. Recorded precipitation was more than 20 inches less than the long-time average up to November 1, 1942. Such rainfall as occurred was well distributed insofar as row-crops were concerned, and yields of

Table 1. Summary of results from beef calf project, State College, 1941-1942.

Original cost of 21 cows brought to College plus 2 of the 3 that died at first sale:	
23 head @ \$32.00, February 1941	\$ 736.00
1 bull	160.00
Total cattle investment	\$ 896.00
Sales	
1 cow, June 1941	\$ 34.50
5 calves, November 1941	150.00
1 cow, December 1941	40.00
9 steer calves, October 1942	421.29
Total on hand	\$ 1169.60
On hand November 1, 1942	
1 bull	\$ 160.00
18 cows—weight: 14,620 pounds @ 8¢	1169.60
6 heifer calves @ \$45.87	275.22
Total on hand	\$ 1404.82
Sales plus value on hand	\$ 2251.39
Total increase over original investment	\$ 1355.39

cotton and corn in the affected area are above the long-time average. Yields from pastures and meadows were markedly reduced, however, and the ample supply of pasture clippings used during the winter of 1941-42 for wintering cattle at State College and in the Area, will not be available during the winter of 1942-43. These facts should be considered in evaluating results in grazing and beef calf production both at State College and in the Land Use Research Area.

Results Thought Representative

Results of the calf production work in 1941 and 1942 at State College are in many ways, perhaps, representative of returns which may be secured from beef calf production under conditions of good management on a large number of farms. A normal calf crop was secured, and the calves averaged more than 400 pounds at weaning. They were sold on a competitive market at an approximately just price. Losses by death of cows originally purchased were about the average of other trials reported. The income from sales was more than enough to pay off the original investment in less than 2 years, and the present herd of 18 cows and 1 registered bull is almost clear profit.

Beef Calf Production at Holly Springs Branch Station

The Holly Springs Branch Experiment Station was established in 1904, and at that time the land included in the Station farm was badly eroded and gullied. Efforts to reclaim the soil for row-crop production were only partially successful; first, because of the large number of gullies, and second, because of the steep slopes and the erosive character of the soil. The hillier phases were early converted into pastures and the effort was made to utilize only the more gentle slopes for crop production.

These pastures were first utilized by

dairy cows, but the pastures gradually became infested with wild onion, and the onion flavor made unmarketable, during much of the year, the milk produced by cows grazing on these pastures. Beef cattle were introduced primarily to utilize the onion-infested pastures as well as to demonstrate the feasibility of beef production in north Mississippi and to provide beef animals for various experiments.

Holly Springs is located in the brown loam area. The brown loam (and loess) extends throughout Mississippi from north to south, bordering the valley of the Mississippi River; it includes all or parts of some 29 counties, and comprises very roughly about one-fourth of the land area of the state. Brown loam soils are quite variable in contour, ranging from comparatively level plateaus, to rolling hills, to the "bluff section" which adjoins the Delta area.

Brown loam material is of wind-blown origin, and varies quite widely in depth, that portion close to the river being many feet deep while its eastern side merges gradually into other and less fertile soils. The depth of the brown loam material may vary quite widely on any one farm, except in the "bluff section." Generally speaking, the pastures at Holly Springs are in the thinner and less fertile phase, especially where erosion has exposed the less fertile sandy subsoil.

Pasture Used in Program

The pastures used in the beef cattle project included from 90 to 100 acres, of which about 15 acres was woodland which furnished little or no grazing. Approximately 75 acres of this tract has long been in pasture, and about 20 additional acres of land too steep for cultivation without excessive erosion had recently been converted into pasture. All of the tract was treated with superphosphate in 1937 and has since been mowed or clipped as needed, usually twice a year. It



Figure 2. Native south Mississippi cows on arrival at Holly Springs Branch Station in early March 1941. Note emaciated condition. These cows produced a 96.6 percent calf crop in 1942 and have almost doubled in weight.

is estimated the Holly Springs pastures have doubled in efficiency since these pasture practices were inaugurated.

The pasture forage consists of common lespedeza, bermuda grass, and hop clover, but since the application of basic slag and the clipping program, Dallis grass and White Dutch clover are increasing. But little seeding of pasture grasses and clovers has been done. Generally speaking, the pasture might be classified good for the area but not yet representative of the best that can be developed in the area.

Breeding Animals Used

On March 8, 1941, the Animal Husbandry Department of the Mississippi Experiment Station purchased at Picayune, Mississippi, 30 native south Mississippi or "scrub" cows, for the Holly Springs Branch Station at a cost of \$30.00 each and a total cost of \$990.00 with transportation costs added. Shortly afterward, a registered Aberdeen Angus bull was purchased at a cost of \$200.

Two cows already owned by the Station and added to the beef herd, were

valued at \$30.00 each. The total investment in 30 cows purchased, 2 cows added to the herd, and 1 bull, was therefore \$1250.00.

On delivery at Holly Springs, the cows were in a badly run-down condition due to the long haul and their poor flesh at the end of the winter. Figure 1 shows a group of these cows shortly after arrival at Holly Springs. Two of these cows died in the course of a few weeks; a third cow required veterinary treatment, but recovered. A fourth cow dislocated her hip and was sold near the end of the year for about what she cost.

Marketings, 1941 and 1942

The 8 calves produced in 1941 were sold on the Memphis market for a total of \$229.42. This amount deducted from the amount invested in the herd leaves a net investment in the herd of \$1020.58. During December of 1941, 2 more of the cows dropped scrub calves, and these calves were carried over into 1942 and sold with the 1942 calf crop.

The beef herd was grazed on the Sta-

Table 2. Summary of results, beef calf project, Holly Springs Branch Station, 1941-1942.

Original cost of cattle	
30 cows @ \$30.00, February 1941	\$ 900.00
\$3.00 per head transportation cost	90.00
2 cows added from station herd @ \$30.00	60.00
1 bull	200.00
Total cattle investment	\$ 1250.00
Sales	
1 cow with dislocated hip and 9 calves sold December 1941	\$ 229.42
23 calves sold fall 1942	1209.32
Total sales	\$ 1438.74
On hand November 1, 1942	
29 cows—22980 pounds @ 8c	\$ 1838.40
1 bull	200.00
5 calves—740 pounds @ 12c	88.80
Total on hand	\$ 2127.20
Sales plus value on hand	\$ 3565.94
Total increase over original investment	\$ 2315.94

tion pasture described above throughout the 1941 and 1942 grazing periods. They were wintered during the 1941-42 period on a 30-acre pasture on the North Station farm, largely on pasture clippings which had been cut and handled as hay and stacked on the pasture. Beginning with December, they were fed an additional 600 pounds of rough hay daily until April 7. During the last 30 days, after many calves had been dropped, the cows were fed an additional 100 pounds per day of low quality corn in the husk by simply scattering it on the ground.

At the beginning of 1942, the beef herd included 29 cows from which 23 calves have been sold for a total of \$1209.32. The calves weighed at Memphis 9850 pounds, an average of 428 pounds per calf. Five small late calves remain, weighing on October 28, 1942, 740 pounds.

In the main, the calves sold at prices near the top of the Memphis market as follows:

- 11 calves at 13c per pound.
- 6 calves at 12½c per pound.
- 5 calves at 12c per pound.
- 1 calf at 11c per pound.

In addition to the 23 calves marketed,

5 late calves were not marketed and 1 additional cow will calve late in 1942. This would indicate a 96.6 percent calf crop, which is exceptional. An 80 percent to 85 percent calf crop is generally considered about average in a well managed beef production program.

Since the total investment in the beef herd (\$1250) was reduced to \$1020.58 by the sale of beef calves in 1941, the sale of calves totaling \$1209.32 in 1942 was sufficient to recover the remainder of the livestock investment and supply \$188.74 profit. In addition, the herd of 29 native cows and the registered beef bull, worth approximately \$2038.40, and 5 calves, remain on hand, paid for by beef calf production, and ready to earn more profit while producing more beef to supply war needs.

The cows are in thrifty condition and would sell on the market probably at considerably more than the original cost. Thus, it would appear that more than \$1200 has been secured in gross returns during 1942 from approximately 80 acres of land unsuitable for row-crop production or for the production of milk.

Financial and production data are shown in summary table 2.

One point is of further interest. The native cows were emaciated on arrival at Holly Springs, but started rapid gains shortly after grazing was available and have continued to gain during two grazing seasons. As shown in table 3, the average weight on receipt of the cattle in March 1941, was 403 pounds per cow. In September 1941, the average weight was 711 pounds per cow, and in September 1942, the average weight was 792 pounds per cow.

Beef Calf Production at the Natchez Branch Experiment Station

The Natchez Branch Experiment Sta-

tion was established in 1926 and its early work was concerned with general farming experiments together with pioneer work in the propagation of pecan trees. In 1939, in view of increased interest in livestock production in southwest Mississippi, it was thought wise to devote the work of the Natchez Branch Station to research in livestock, pastures, and forage crops.

The Natchez Branch Experiment Station is located in the deep phase of the brown loam area which is briefly described in the Holly Springs section of this report. Some 40 acres of comparatively level and fertile soil is used mainly for crop production experiments. Approxi-

Table 3. Weight of cows and calves March 8, 1941, Sept. 6, 1941, and Sept. 1, 1942, Holly Springs Branch Station.

Cow No.	Weight*	Weight	Weight
	March 8, 1941	Sept. 6, 1941	Sept. 1, 1942
0 Not numbered			700
1 Not numbered		1000	1080
2 Tag lost			800
3 Tag 130		650	750
4 Tag 129		630	710
5 Tag 515661		680	700
6 Tag lost			820
7 Tag 127		700	750
8 Tag 52178		630	650
9 Tag 183		600	900
10 Tag 517540		700	780
11 Tag lost			760
12 Tag 488562		740	800
14 Tag 135		680	780
15 Tag 291		730	760
16 Tag lost			860
17 Tag lost			800
18 Tag 33875		760	830
19 Tag 139		670	730
20 Tag lost			840
21 Tag 529710		750	760
22 Tag lost			770
24 Tag lost			750
25 Tag 181		750	750
26 Tag 184		880	960
27 Tag 33848			950
28 Tag lost			790
29 Tag lost			640
40 Tag 180		550	810
Total	11700	12100	22980
Average weight per cow	403.4	711.7	792.4

*28 cows purchased, plus 1 calf; 2 cows died, not included in weight.

mately 240 acres of the remainder is rough and hilly, but the wind-blown material is deep and comparatively fertile.

Pasture Development Program

Under the livestock research program, about 240 acres of land has been devoted to pastures and meadows. Pasture development has consisted of clearing land of trees, brush and briars, building ponds, fences, terracing, seeding, and mowing. A view of the Natchez Station pastures, photographed in June 1940, and shortly after the preliminary work was done, is shown in figure 1.

All of the pasture area was fertilized with phosphate at the rate of 40 pounds P_2O_5 per acre, the sources being basic slag on some portions and TVA phosphates on other portions. To supply the desired amount of phosphate required approximately 500 pounds basic slag or 250 pounds 20 percent superphosphate per

acre. Dallis grass was seeded early in 1940 at the rate of 12 to 15 pounds per acre, and White Dutch clover was seeded the following fall at the rate of 4 pounds per acre. A volunteer stand of lespedeza was thought sufficient and no additional seeding was made. The pasture has been mowed or clipped twice each year since early in 1940.

50 Native Cows Purchased

In preparation for livestock feeding, grazing, and breeding experiments, it was decided to purchase a foundation herd of native south Mississippi cows and to grade up this herd by the use of registered beef-type bulls. In January 1940, 25 cows were purchased, and in September 1940, 25 additional cows were purchased. These were acquired from Lamar and Pearl River Counties, showed little or no admixture of beef or dairy breeding, and were fairly representative of native south



Figure 3. Native south Mississippi cows on pasture at Natchez Branch Station in June 1940. Note that all cows are in fair flesh after about 100 days on good pasture.



Figure 4. A view of the 240-acre pasture, Natchez Branch Station, showing terrace, water disposal, and first-year cover of pasture grasses and clovers.

Mississippi cows. Two heifer calves produced by the first group have since been added to the herd. The breeding herd contained 47 cows at the end of 1942. A registered Hereford bull and a registered Polled Hereford bull were purchased at a cost of \$400.

Beef Production Management

In beef calf production it seems desirable that calves be dropped at a relatively uniform date in the spring, so that the calf crop may reach maximum growth and be marketed in the fall. This is accomplished by keeping the bull with the herd for a limited period only, which is usually June, July, and August. In acquiring range-bred cattle, however, no such regularity in calving occurs; and in order to secure the desired regularity in calving, a portion of the breeding period is lost and a low percentage calf crop results during the first year or two. This fact accounts in large measure for the low

percentage calf crop secured at the Natchez station.

The beef herd has been confined to the pasture area exclusively since arrival at the Station. No barns or other cover is provided. The standard State College beef cattle wintering ration is fed at Natchez. It consists of the following ingredients fed daily per 1000 pounds live weight:

- 30 pounds sorghum silage.
- 5 pounds grass hay
- 1 pound cottonseed meal.

No other cattle included in this report were fed the standard wintering ration, those at State College, Holly Springs, and the Land Use Area being wintered in the pasture on pasture clippings supplemented by small quantities of concentrates.

Summary of Marketings

One steer calf weighing 575 pounds was marketed in the fall of 1940 for \$43.14 and 1 cow for \$31.

Of the 1941 production, 21 calves weighing a total of 6150 pounds were marketed in the fall of 1940 for a total of \$470.82.

Four 2-year old steers were also marketed in the fall of 1942. These weighed 2610 pounds and, at \$8.72 per 100 pounds, were sold for 227.49.

The calves marketed in 1942 were all steers, the heifers being reserved for use in the breeding herd. All were sired either by a Hereford or a Polled Hereford bull, and were dropped in March and April with one or two exceptions where late calves were dropped in May. All calves were sold individually at an auction sale which is held each week in Natchez. Results from the sale of 17 steer calves are shown in table 4.

The 1942 calves were divided into two groups and sold at different times. This was done to obtain some information as to the differences in prices received for calves sold early in the fall as compared with prices received for calves sold not long before frost. It is believed that early marketing of the calf crop might permit the cows to get in better condition before winter sets in.

The first group consisted of 9 steers and was sold on September 3. The average weight at market was 301 pounds, with the weights ranging from 240 pounds for the lightest to 420 pounds for the heaviest. The average price received was \$11.69 per 100 pounds live weight, with the price varying from \$10 for the lowest to \$13.50 for the highest.

The second group consisted of 8 steers and was sold on October 29, or about 2 months later than the first group. The average weight at market was 345.6 pounds, with the weights ranging from 285 pounds for the lightest to 415 pounds for the heaviest. The average price received was \$10.46 per 100 pounds live weight, with the price ranging from

\$10.10 for the lowest to \$10.70 for the highest.

The average price for the 2 lots of steers was \$11.07 per 100 pounds live weight. The average weight was 323.3 pounds per calf.

The average price received for steers in the early marketed group was \$35.18 each. The average price received for steers in the late marketed group was \$36.14. Sales of the 2 lots of 1942 steer calves totaled \$1377.14. Results are shown in table 4.

In addition to the steer calves sold, 9 heifer calves were reserved to be added to the breeding herd. These averaged approximately 400 pounds in weight on November 1, and for the purpose of this report are valued at \$10.46 per 100 pounds live weight, which is the price received for the steer calves marketed in the late group. On this basis, the average value was \$41.84, and the total value was \$376.56 for the 9 heifers reserved for the breeding herd.

The total amount received from the sale of 39 calves, 1 cow, and four 2-year old steers is \$1377.14. In addition, one 2-year old heifer and 9 heifer calves reserved for the breeding herd were valued, on the basis of other sales, at a total of \$431.56. The total from sales and from increase added to the breeding herd amounted to \$1808.70. This amount exceeds the original expenditures for cows but lacks slightly under \$150 of defraying the additional cost of 2 registered bulls.

The Penalty of Overstocking

Since 47 cows were included in the beef calf producing herd in 1942, this would indicate a 55 percent calf crop. An 80 to 85 percent calf crop is usually considered normal, and the low percentage in the Natchez experiment is probably attributable in part to contagious abortion, in part to a change in the breeding rhythm, and in part to insufficient pasture forage.

Results secured in the Natchez beef calf production project were not as favorable as those secured at Holly Springs or at State College or in the 2-year trial in the Area. This is due in large part to the fact that the 1942 calves from Natchez were lighter in weight than from the other producing units. It is believed that this condition was due to the overstocking of pastures.

The Natchez pastures were first established in 1940 by the proper application of approved pasture building practices, in-

cluding seeding, fertilization, and mowing. However, grazing was begun before these pastures were fully established, and the pastures have been heavily stocked at all times. During the summer of 1942, for example, a total of 110 grazing animals were on the 240 acre pasture. It is likely that a smaller number of animals would have yielded more profit, but it was thought necessary to breed up the experimental herd as rapidly as possible, and the maximum number of animals was carried for that purpose.

Table 4. Summary of results, beef calf project, Natchez Branch Station, 1940-1942.

Original cost of cattle.	
25 cows, January 1940 @ \$31 delivered	\$ 775.00
25 cows, September 1940 @ \$31 delivered	775.00
2 bulls	400.00
Total cost of cattle	\$ 1950.00
Sales	
1 steer calf, fall 1940, 575 pounds @ \$7.50	\$ 43.14
1 cow	31.00
21 calves, fall 1941, 6150 pounds @ \$7.66	470.82
4 2-year old steers, fall 1942, 2610 pounds @ \$8.72	227.49
17 steer calves, fall 1942	604.69
Total sales	\$ 1377.14
On hand November 1, 1942	
47 cows @ \$55	\$ 2585.00
1 2-year old heifer	55.00
9 heifer calves, 3600 pounds @ \$10.46	376.56
2 bulls	400.00
Total on hand	\$ 3416.56
Total sales plus value on hand	\$ 4793.70
Total increase over original investment	\$ 2843.70

Beef Calf Production on the Oktibbeha-Winston Land Use Research Area

As a part of the effort by the Federal government to relieve depression in the Thirties by removing farmers from poorer producing to better producing agricultural areas, some 90,000 acres of submarginal land in several east central Mississippi counties, were purchased by the United States Department of Agriculture. Approximately 4000 acres of this tract has been leased to the Mississippi Agri-

cultural Experiment Station through the Soil Conservation Service for land use investigations.

A portion of the leased tract is being utilized by the Dairy Department for dairy investigations, and a larger portion is being utilized by the Animal Husbandry Department for livestock investigations. This experimental unit has been named the "Oktibbeha-Winston Land Use Research Area," and is more briefly referred to as "the Area." Reference is made in this report only to the Animal Husbandry investigations, which are large-

ly concerned with grazing, pasture-building, and forage production.

Infertile Soil for Pastures

The upland soils included in the tract are mostly Lufkin, and as a whole, are fairly characteristic of the flatwoods area. The flatwoods area in Mississippi is a relatively narrow strip of land extending from near the Tennessee line in a southeasterly direction and entering Alabama about midway of the Mississippi-Alabama line, and includes portions of 13 counties. As a whole, flatwoods soils are usually classified as among the least desirable in Mississippi. As the name would indicate, flatwoods soils are level or gently undulating in conformation; but, unfortunately, are deficient in essential plant nutrients. Flatwoods soils are made up of plastic clay materials and the lack of undersurface drainage makes them susceptible to injury either by drouth or excessive rainfall. The fact that this large body of land was classified by Federal authorities as submarginal, is indicative of the low-producing capacities of the soils under the prevailing system of row-crop farming.

BEEF CALF PRODUCTION CONDUCTED TWO YEARS

In an effort to determine whether these soils could be profitably utilized as pasture land, the Experiment Station started in the spring of 1941 a series of grazing experiments. This work was greatly extended in 1942.

The establishment of productive pastures has only recently received a merited degree of attention by research workers. In the case of the Area, where land values were low and where it was thought that pasture production capacity was low, it was commonly believed that only a minimum investment in pasture preparation would be justified. Hence, in the grazing experiments initiated in 1941, only the minimum pasture work was done.

Experimental Pastures

Three pastures, each including about 80 acres of open land, were fenced separately. The open land had been cultivated previously, but had not been cultivated for 5 or more years and contained a very considerable growth of small trees, brush, briars, and similar undesirable plant growth. Common labor, paid at the rate of \$1 per day, and conventional farm tools, mainly including axes, cross-cut saws and kaiser blades, were used in the brushing program. All stumps were cut at or below the ground level and all brush was piled and burned, so that the pasture area was prepared for the use of the mowing machine.

The work of preparation is fully described in Circular 108 and was done at a cost of \$2.38 per acre.

It has been observed that the use of the mowing machine twice or three times a year on this brushed-off land has effectively controlled sprout growth; in fact, sprout growth was almost completely eliminated during 1942, the second year of the mowing program.

At the beginning of this work, the predominating growth was broom sedge, but more or less common lespedeza was present; and the combination of grazing and mowing has not only served to keep the broom sedge palatable and relatively nutritious, but has also permitted the rapid growth and distribution of lespedeza cover. No seedings have been made of desirable pasture plants. Only one of the three pastures has been fertilized; and results have been such that, insofar as this report is concerned, the flatwoods pastures may fairly be considered as unfertilized.

3 Lots of Native Cows Used

In February 1941, 90 cows were purchased from south Mississippi at a cost of approximately \$32 per head delivered to the Area. This group of cows was in a low state of nutrition, as illustrated in

figure 1, and 8 cows died shortly after arrival. One additional cow developed lump jaw and was disposed of. The remaining 81 cows were divided into 4 lots, each lot headed by a registered Hereford bull; and 3 lots, totaling 60 cows, were placed on the Area pasture, and the fourth lot, containing 21 cows, was placed on the State College pasture.

The State College group is treated elsewhere in this report.

Herd Management Practices

The Area cattle were placed on three separate pastures about May 1, 1941, and have utilized two full grazing seasons. They were wintered on the same pastures in 1941 and 1942. No shelter was made available, the cattle receiving protection in woodland portions within the pasture areas. The winter ration consisted of hay stacked in the pastures at the time of the second clipping. The hay was of low grade, consisting principally of broom sedge, but maintained the cattle until March 1, 1942. At that time, the cattle refused to eat the remaining hay, and better quality hay was secured and fed to them. Three cows died during the win-

ter, which might indicate the necessity for better hay than was available from broom sedge.

Beef Calf Marketings

Calf production was low during 1941. Eleven calves produced by the 60 cows were sold at weaning for \$275.

Seven of the 11 cows that calved in 1941 did not produce calves in 1942, while only 2 of these cows calved too late for possible 1942 production. Of the 55 cows remaining, 41 produced calves. This was a 74.5 percent calf crop, which was slightly less than normal. One cow died for unknown reasons in July 1942, and her calf was sold for \$22.50.

Of the 1942 production, 22 steer calves were marketed through Swift and Co., Montgomery, Alabama, at an average selling price of \$11 per 100 pounds live weight, minus 3 percent shrinkage, State College weights, and shipping charges paid by the buyer. The average weight per calf was 402 pounds, and the average selling price per head was \$42.90.

Eighteen heifer calves were weaned in late October and kept for breeding purposes. These weighed on the average

Table 5. Summary of results of beef calf project, Land Use Area, 1941 and 1942.

Original cost of cattle.	
67 cows @ \$32.00, February 1941	\$ 2144.00
3 bulls	480.00
Total cattle investment	\$ 2624.00
Sales	
1 cow, February 1941	\$ 18.40
11 calves, November 1941	275.00
1 calf, July 1942	22.50
5 cows, October, 1942	338.55
22 steer calves, October 1942	944.24
4 cows died—no value recovered	
Total sales	\$ 1598.69
On hand November 1, 1942	
3 bulls	\$ 480.00
50 cows, weight 34,465 pounds @ 8c	\$ 2757.20
18 heifer calves @ \$37.62	677.16
Total value on hand	\$ 3914.36
Sales plus value on hand	\$ 5513.05
Total increase over original investment	\$ 2889.05

353 pounds each, including 2 very late and small calves. At the same valuation as the steer calves were sold for, the heifer calves had average market values of \$37.62 each.

The 40 heifer and steer calves carried until October 3 had an average weight of 380 pounds and an average net value of \$40.59.

Original Investment Nearly Doubled

During the period of less than 2 years, the original investment was almost doubled by the increase. The 67 cows and 3 bulls cost \$2624. Sales totaled \$1598.69 and 18 heifer calves kept for breeding were valued at \$677.16, giving a value of \$2275.85 to the calves produced. This amount subtracted from the original investment of \$2624 leaves \$348.15 still invested in 50 cows and 3 bulls.

The 50 cows on hand had increased to 34,465 pounds in weight and, on the basis of 5 cows sold, were worth 8 cents per pound, or a total of \$2757.20. The income from sales plus the value of cattle on hand equals \$5513.05. This is a total increase of \$2889.05 and is almost equal to the original investment.

Details of the financial statement are shown in table 5.

BEEF CALF PRODUCTION CONDUCTED ONE YEAR

During the winter of 1941-42, it was decided to increase the livestock grazing phase of the land utilization research work in the Area; so additional pasture land was cleared up and otherwise prepared for mowing, and additional beef breeding animals were provided.

Additional Pastures Established

Altogether, some 400 acres of land was brushed and prepared for mowing as described in the preceding section. The work of preparation differed from that of the preceding year in that the 1942 project was much larger in scope, but was not so exactly defined as the project start-

ed in 1941 while preparations were being made for rather exact experimental work. In the 1942 pasture development program, no new fences were constructed, but those standing were used. This resulted in three large pastures, the greater portion of which were in woodland and only smaller portions could be prepared for pastures without excessive expense for land clearing. The fenced areas included altogether approximately 1800 acres, from which it will be seen that less than 25 percent of the fenced area might be fairly considered as pasture land.

The soil included in the 1942 pastures also differed somewhat from that included in the pastures established in 1941. Perhaps three-fourths of the area prepared for pasture in 1942 consisted of bottom and second bottom land adjoining Noxubee River and small tributaries, whereas all of the land prepared for pasture in 1942 was upland.

During the very dry year 1942, it might have been expected that the bottomland pastures would have yielded more abundantly of pasture forage. However, references to the preceding table 5 will reveal that the upland pasture produced surprisingly well in terms of beef calves marketed. It is believed that the greater part of this difference is due to the fact that 1941 pastures had been mowed and clipped for 2 years, whereas none of the 1942 pasture area was clipped more than 1 year and much of it was cleared as late as midsummer and was mowed only once.

Repeated mowings appeared to make the pasture forage more edible and nutritious on all mowed areas, and in addition, the cover of lespedeza was better on pastures mowed 2 years than on those mowed only 1 year.

The work of preparation was similar in essential respects to that done in 1941. Trees, bushes, stumps, briars, and other undesirable growth was cut at or below the ground level, then piled and burned.

That portion which was thus treated early in the season was mowed from twice to three times, while portions prepared later in the season were mowed before the brush was burned, and afterward as seemed necessary. There was a definite shortage of available labor during 1942 which made it impossible to get done all the work desired, at the time needed.

180 More Cows Purchased

To stock this area, 180 cows plus 25 calves were purchased in Forest and Stone Counties during February and March, 1942. The cost of the cows ranged from slightly under \$40 to slightly over \$40, and averaged \$41.11. The calves were mostly small and were purchased with their mothers at an additional cost of \$5 each. The cost of freight and trucking

was \$292.39, making a delivered cost of 180 cows and 25 calves \$7827.39.

Three registered Hereford and 3 Aberdeen Angus bulls were purchased, at a cost of \$1200. The total investment in the breeding herd was \$8716.19.

Nine additional cows died in March and early April, 1942. These cows apparently died of under-nutrition, but refused to eat the feed offered them.

Advantage was taken of experience gained in purchasing other lots of cattle from the south Mississippi area in the preceding years, and a very good first-year calf crop was secured. The cows purchased were carefully selected on the basis of comparatively good condition, it being believed that even comparatively good condition would indicate either that the cows had not produced calves during



Figure 5. This pasture was cleared of brush in the spring of 1942, and has been mowed twice. Note sprouts, which are much less vigorous than earlier, but which need another mowing this year.

the preceding years or that they had produced and weaned calves early enough to gain good flesh and condition before winter set in. Whatever the cause, 164 cows remaining in the breeding herds throughout the year produced 124 calves, which is a calf crop of 75.6 percent. Reference to first-year yields of native south Mississippi cows in other sections of this report will reveal that fully twice as many calves were secured in the 1942 purchase as in any of the 1941 purchases.

Marketing Within 8 Months

All of the calves produced during 1942 were marketed through a commission company in St. Louis, Mo., on October 16, 1942. The sales are itemized in the financial report as shown in table 6. The 124 calves yielded net proceeds of \$3384.27.

Reference to the financial report (table 6) will show that the calves varied quite widely in weight and in price per 100 pounds live weight. The variation in weight is due in largest part to variations in age, some of the calves being dropped extremely early and some extremely late. (It is to avoid a situation of this kind that bulls are kept with the Station's breeding cows during a limited period each year, so as to secure calves of comparatively uniform birth dates and ages.)

The original investment in the 173 native cows and 25 calves was reduced about 8 months after purchase from \$7516.19 to \$4132.92 by reason of sales netting \$3384.27, so that the investment remaining in 164 cows is \$25.20 each.

The 164 cows remaining were in comparatively good flesh at the beginning of winter, are bred to pure-bred beef bulls, and are heavier than when purchased. On the basis of sales of similar animals by the Experiment Station, these cows are valued at \$55 each, or a total of \$9020. This amount, plus the value of the 6 bulls, gives a total value of stock on hand of \$10,220. The amount received from sales

and the value of animals on hand totals \$13,604.27. This is a total increase over the original investment of \$4888.08.

Good Calf Crop First Year

Results from the 1942 project in the Land Use Research Area are not comparable to results from any other project included in this report, except the percentage of calves secured the first year. This material is included to establish, first, that an approximately normal calf crop may be secured by careful selection of the breeding animals, and second, that substantial progress can be made in beef calf production on otherwise unimproved pastures if the practice of mowing is followed.

Mowing Highly Beneficial

The beneficial results of mowing were clearly marked in this project. In view of the fact that less than a fourth of the land within the pasture fences was mowed, it seems clear that the choice of the grazing animals would indicate comparative quality of the pasture herbage. It was quite noticeable throughout the grazing season that the cows showed a marked preference for the mowed areas. On more than one occasion, it was noticed that knee-high grass, often including lespedeza, was apparently untouched by the grazing animals, whereas adjoining mowed areas were cropped quite close to the ground.

From observations made in the Land Use Research Area, both in 1941 and 1942, and in which mowing was the only pasture improvement practice followed, it is believed that beef calves can be produced with some degree of financial success, under prevailing prices, on a very large percentage of the hill land in Mississippi, provided the prospective pasture land is prepared for mowing and is thereafter mowed twice or three times each year.

The beneficial effect of further improvement practices, including the seeding or sodding of desirable species, and

adequate fertilization, are quite apparent and are made much easier to the average farmer by the liberality of the 1943 AAA pasture improvement program.

General Discussion of Results From the Four Beef Calf Production Projects

This study of income derived from beef calf production includes results from five separate tests conducted at four locations on three soil types, includes results from three methods of pasture development, and gives returns from marketing in four separately-located livestock markets.

The one point of uniformity is that native south Mississippi cows were used for beef calf production. These cows are descendants of the old "piney woods" cattle, which were brought into Mississippi by the early settlers, and which in the lower part of south Mississippi, are still unmixed with either dairy or beef breeding. Undoubtedly they are strongly constituted, having come through a "survival of the fittest" environment for many generations. They are larger in frame, generally speaking, than are grade Jerseys, and increase considerably in body size when given access to good pastures. Apparently, the south Mississippi cows are

Table 6. Summary of results of beef calf project, Land Use Research Area, 1942.

Original cost of cattle.		
180 cows @ \$41.11, February 1942		\$ 7410.00
25 calves @ \$5.00		125.00
Freight and trucking		292.39
Total		\$ 7827.39
Less indemnity for 7 cows died in transit		311.20
Delivered cost of 173 cows and 25 calves		7516.19
6 registered bulls (3 Hereford, 3 Angus)		1200.00
Total investment in breeding herd		\$ 8716.19
Sales, October 16, 1942		
13 calves, 1930 pounds @ \$12.50		\$ 241.25
25 calves, 6400 pounds @ 12.75		816.00
11 calves, 2620 pounds @ 14.00		366.80
17 calves, 3230 pounds @ 14.00		452.20
20 calves, 3860 pounds @ 10.75		414.95
23 calves, 7200 pounds @ 11.00		792.00
11 heifers, 5030 pounds @ 8.75		440.12
2 yearlings, 810 pounds @ 8.00		64.80
1 steer, 400 pounds @ 10.50		42.00
1 calf, 210 pounds @ 9.00		18.90
Total		\$ 3649.72
Freight and back charges (2 cars)	\$189.01	
Yardage	41.96	
Commission	34.48	265.45
Net Proceeds		\$ 3384.27
On hand, November 1, 1942		
164 cows (9 died during winter 1942) @ \$55.00		\$ 9020.00
6 registered Hereford and Angus bulls @ \$200		1200.00
Total value on hand		\$10,220.00
Sales plus value on hand (\$3,384.27 plus \$10,220.00)		\$13,604.27
Total increase over original investment		\$ 4,888.08

less infested with various bovine diseases. Apparently, also, they provide a good flow of milk, resulting in healthy, rapidly-growing calves which sold at better than average market prices. The fact that these cows, costing \$31 to \$33 in 1941 and \$40 to \$45 in 1942, produced calves often averaging over 400 pounds in weight and selling for approximately \$40 each, seems proof enough of their efficient performance as producers of beef calves.

Loss of Cows by Death

It will be noted throughout this report that considerable loss occurred by reason of death soon after the cows were shipped. These cows were purchased in Pearl River, Lamar, and Forrest Counties in late winter. They were in poor flesh and, in many instances, were not strong enough for the long freight haul. Perhaps trucking would be preferable, especially for smaller lots and if trucks are available. Perhaps, too, it would have been better had the cows been purchased in late fall or in early winter, while in good flesh. In July 1936, 60 cows were moved by freight from Poplarville and Lumberton to State College, without a single loss.

First-Year Calf Crop

It will be noted too, that except in the case of the 1942 purchase, a small calf crop was secured during the first year. Cattlemen report that the range cows of south Mississippi usually produce calves only on alternate years. Profiting by the previous year's experience, this situation was largely avoided in 1942. Cows were selected which were in comparatively good flesh at the time of purchase, thus indicating that calves had not been produced in 1941. A satisfactory calf crop was secured in this manner.

In all of the tests but one, the herd bull was kept with the cows only during the normal breeding season so as to have the calf crop dropped early and within a limited period. At Holly Springs, the

herd bull was kept with the cows at all times, which may account for the fact that the highest percentage of calves from breeding cows was secured at Holly Springs.

Pasture Management Practices

The pastures used in these tests were located in the flatwoods area, the prairie area, in a thin phase of the brown loam area, and in a deep phase of the brown loam area. Regardless of original fertility or pasture treatment, differences in pasture yields, as measured by calf production, are not as great as might have been expected. The pasture at State College is on lime and mineral-rich soil, and has gradually been developed over a long period of years. Until recently, it was not thought necessary either to fertilize or to plant seeds of desirable pasture grasses and clovers on these soils. More recently, however, prairie farmers are seeding White Dutch clover, lespedeza, black medic, and Dallis grass to more rapidly develop their pastures.

Fertilizers will be applied on all the Animal Husbandry pastures at State College during the winter of 1942-43.

The pasture at Holly Springs is on a rather thin phase of brown loam soil and is moderately supplied with lime and phosphate. This pasture has been grazed for many years, but recent improvements, mainly by fertilization and a limited amount of seeding, have, apparently, approximately doubled yields in pasture forage.

The Natchez pasture is on a deep phase of brown loam, or loessial soil, and has been developed since 1939, largely from brush land or cultivated land, under approved and recommended pasture establishment practices. Liberal quantities of phosphate and lime have been applied and desirable species of grasses and clovers have been seeded. It is believed that practices followed at Natchez,

and as generally recommended, are applicable throughout Mississippi.

Benefits of Mowing Pastures

The pastures in the Land Use Utilization Area are located on infertile flatwoods soil. No seeding has been done and but little fertilizer has been applied. The pastures were prepared for mowing in 1941 by the removal of brush, stumps, briars, and other obstacles, and have been mowed two to three times in each of the years 1941 and 1942. The pasture herbage was originally composed almost entirely of broom sedge, but volunteer common lespedeza is rapidly becoming established and volunteer Dallis grass is increasing. These pastures were established for a minerals experiment and the method of establishment employed is not recommended for general use. However, these pastures do illustrate what can be done with the very least expenditure for preparation and maintenance.

Throughout the pasture studies, the highly beneficial results of mowing have been outstanding. It is believed that mowing or clipping twice or three times each year is the first essential to pasture establishment and maintenance in all areas of Mississippi.

Marketing Facilities

It may be noted from the previous discussions that the cattle sold from the different projects were marketed in various ways. A few cattle were disposed of simply by private bargaining between those selling the animals and some local buyer. In several instances animals were sold through auction sales held in the nearby community. In a few cases they were trucked to a central market for selling. Others were shipped by rail to a central market and sold. In each case the cattle were disposed of by that means which was considered most feasible and profitable under the existing conditions.

While many factors enter into decid-

ing how one's cattle should be marketed, the point having the greatest bearing on such a decision is the number of live-stock being sold. When the number of cattle being sold is small it is usually necessary to sell them through some local channel, since the smallness of the number does not permit the economical use of truck or rail for shipment to a central market. However, when sufficient cattle are available for filling a truck or stock car, it is usually considered advisable to ship them to a central market whenever possible.

A large percentage of all animals leaving farms, including those originally sold locally, ultimately are sold through the channels of a central market. Most locally sold cattle therefore suffer, at the expense of the farmer, a middleman's profit which is usually considerable and frequently excessive. Hence, the more directly a farmer can sell his cattle to their ultimate purchaser the more likely he is to realize their full value, and shipment to a central market is probably the surest way to attain this goal.

By central markets, reference is made to those larger markets usually located near or in certain large meat packing and distributing centers where livestock are consigned to commission firms and sold to buyers on a strictly competitive basis with a definite handling and selling charge previously and uniformly established. National Stock Yards at St. Louis is no doubt the largest one which is frequently patronized by Mississippi farmers. Other central markets of adequate size for efficient marketing available to Mississippi farmers include Memphis, Tennessee; Montgomery, Alabama; New Orleans, Louisiana; and Birmingham, Alabama. Which of these markets the farmers of Mississippi should patronize will depend on the conditions surrounding each individual farmer's circumstances. About all that can be said is that the different markets warrant careful con-

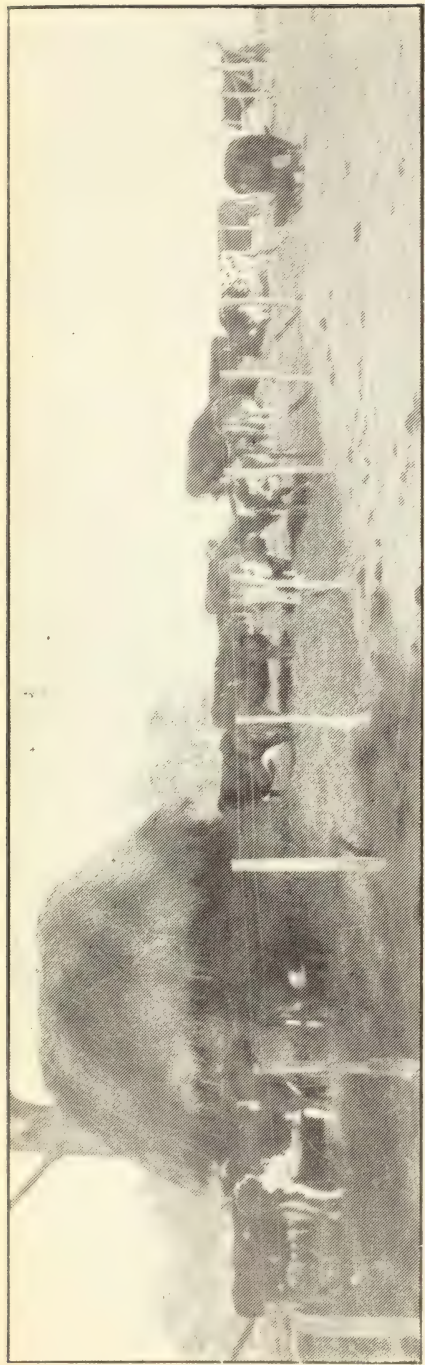


Figure 6. Native south Mississippi cows being wintered on the Station pasture at State College. No shelter is provided and the lot of cows shown has remained on the pasture throughout the year since the late summer of 1936. The hay is cut as a pasture clipping practice.

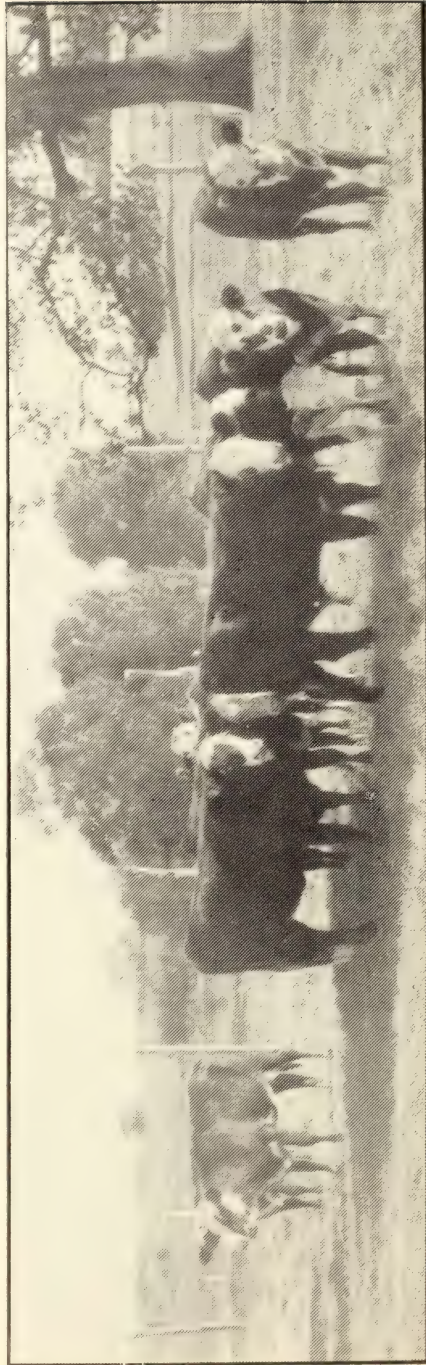


Figure 7. Grade Hereford calves, from native South Mississippi cows, and a registered Polled Hereford bull. This lot, averaging 408 pounds.

sideration by farmers selling different classes of cattle at various times of the year and from different sections of the State.

There are some indications that certain classes of calves, such as those of non-descript breeding dropped from the original cow herds of this study during the first year and sold weighing around four hundred pounds, might sell to better advantage on a central Southern market than in St. Louis, since such cattle are not penalized for their lack of beef breeding to such a great extent in the South. Feeder heifers fall more or less in this same category, since they sell right along with steers on Southern markets but are usually penalized \$1.00 to \$2.00 per hundredweight at St. Louis. However, steer calves showing considerable beef breeding and uniformity will sell just as well or perhaps better in St. Louis than in the South.

It is hoped that sometime in the near future several classes of cattle can be divided into uniform lots, and a lot of each class sold on each of the leading livestock markets to study the suitability of the different markets for the various classes sold. It is realized however, that any findings in this regard would probably be of temporary significance, since the response of farmers to any recommendations made from such findings

would tend to eliminate the existing condition.

Trucking facilities for hauling livestock to central markets are becoming more limited with each day of the war's progress. As a result, an increasing percentage of our record livestock marketings will be shipped to market by rail for the duration and for an unknown time thereafter.

Farmers contemplating the shipping of their cattle to market by rail should familiarize themselves with all of the details connected with the railway shipment of livestock in order to carry on the most efficient marketing program. To do this it is advisable for such farmers to contact their local railway shipping agent several weeks in advance of the date planned for shipment.

Altogether, these findings seem to indicate that beef calves can be successfully produced—and profitably produced, under present market conditions—in many areas and on large numbers of farms throughout Mississippi. It seems clear that the poorer soils produce forage much more abundantly than was the common conception. It appears further that only a minimum-for-efficiency investment is absolutely required for success, although greater success is secured when all of the phases of better management of livestock and pastures are employed.



A Guide To

Planning Clothes

For The Mississippi Farm Family

By
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and
ALICE BOWIE

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MISSISSIPPI

PLANNING CLOTHES
for the
MISSISSIPPI FARM FAMILY

— By —

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Planning Clothes for the Mississippi Farm Family

By

DOROTHY DICKINS, Head Home Economics Department

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Clothing expenses take more of the farm family's money than any one other item except food. In Mississippi, about one-fifth of all the money spent for farm family living is spent for clothing. Is this more or less than it ought to be? And is it spent where and how it is most needed? Scientific tests have shown that a pint of milk a day is essential to a good food supply for an adult, but there are no tests that can show that a rayon dress is essential to the adequacy of a homemaker's clothing supply. Clothing specialists agree that wardrobes should have clothing of the type to protect from cold and moisture and in quantity sufficient for cleanliness. A woolen blanket, several pairs of unbleached cotton undies, a piece of oilcloth and a pair of rubbers would do this. Yet, this combination would not make a satisfactory wardrobe.

Clothing, outer garments especially, is selected not only for comfort and cleanliness, but also for appearance. Having clothes like most other people who attend the same social events is essential to an adequate, satisfying clothing supply. Thus, clothing fulfills a social need and clothing plans for farm people should be based on clothing used by a representative group of socially active farm families. One would no more want to use clothing supplies of members of families with "too little clothing to attend church or school" as a basis for planning clothing budgets than to use food supplies of families with inadequate diets as a basis for planning food budgets.

This bulletin tells what clothing members of socially active white farm families had, the prices of such garments,

frequency of replacement and total cost of replacement during the year (tables 1 through 11). Such information can serve as a guide in planning clothing supplies; should prove valuable in checking the wisdom of one's own clothing choices.

Sources of Information

With this in mind, a representative sample of white families socially active in their communities was selected from 12 beats (or Supervisors' districts); 5 of Webster County, 3 of Madison County, 2 of Grenada County, 1 of Carroll County, and 1 of Monroe County.^{1/} One member of the Home Economics Department of the Experiment Station secured information pertaining to clothing supplies of the members of the 187 families in the sample. All types of families were included, from young couples without children to older couples with all children grown and away from home; from couples with one baby to couples with five children. The average number of members per family was four.

The median income (the income halfway between the largest and smallest) of the families was about \$700 for the year of the study. Income included not only net money income, but also value of occupancy of home, value of home-grown food and other farm products used by the family, and value of inventory change in livestock and crops stored for sale. All families were full-time farm families, but a little over one-half earn-

^{1/}For methods of selecting these families, see pages 1-6, "Clothing Supplies of Socially Participating White Farm Families of Mississippi"—Alice Bowie and Dorothy Dickins, Miss. Agri. Exp. Sta. Tech. Bull. No. 50.

ed money from some other source besides farming. Almost two-thirds of the families owned their farms. Six percent were sharecroppers and the remainder were renters.

This description is intended to give a general picture of the kind of families who furnished the information which is to follow. They were people of moderate income. Most of them did all their own farm and house work. Some of the women and most of the children helped in the field in the summertime, and the women did a lot of the gardening. They also found time to do some family sewing. A large majority had their own sewing machines and most of the rest had the use of a neighbor's or a relative's. Many of the wives and mothers had learned to sew just by "doing it" or by watching and helping when they were growing up. Not many of them had gone to school where home economics courses were given.

Inventories of clothing owned by each member of the family at the time of the visit (October 1939 to June 1941) were made. A record was taken of each garment owned, what it cost, when it was bought, on what occasions it was worn, what condition it was in, and whether it was homemade or ready-made. At the end of the visits there were 759 inventories for all ages and sizes. Some of the inventories of clothing owned were much larger and more expensive than the majority. Others lacked certain heavy garments needed for comfort in the coldest weather. The middle group of 348 individuals which had enough warm clothing and which did not spend exceedingly large amounts, was taken as a guide to what suitably clothed individuals in socially active farm families have on hand and wear. This middle group of 348 individuals was divided into 11 smaller groups based on sex and activity of the individuals: 76 farmers (heads of fam-

ilies), 91 farm homemakers,^{2/} 19 grown boys, 12 grown girls, 16 high school boys, 16 high school girls, 36 grammar school boys, 46 grammar school girls, 16 preschool boys (2 to 5 years of age), 11 preschool girls (2 to 5 years of age), and 9 infants (boys and girls). According to these 11 smaller groups, clothing was summarized to see what garments the majority had at the time the inventory was taken and the usual amount bought in one year. Instead of using the prices which the families paid for the clothing (which prices are now, of course, out of date), each garment is given the price of similar garments listed in the most recent catalogue of a popular mail order house. This information for the different groups is given in the 11 tables below, and may be used by those who wish to check their own clothing supply.

Typical Clothing Supplies and Yearly Replacements

In each of the tables will be found first, the number of garments in the wardrobes of the majority of individuals (typical clothing supplies). The greatest omission in these clothing supplies was of rain and night garments. The members of the families managed without raincoats and hats by remaining at home during very bad weather, or by using their heavy wraps and hats for protec-

^{2/}There were more men in the poorest dressed group than women; more women in the middle dressed group than men. The reasons for this were: (1) Women can be well dressed on less clothing than men. They can make their expenditures go farther by getting material and making clothes at home. (2) Men do work which is harder on clothing. (3) Men have occasion to wear dress clothing more often. The fact that they have to go out for business reasons, even though they do not have much clothing, may make them more willing to go on less. Or, the fact that they are less "clothes conscious" than women and girls may make more of them willing to participate socially with less than the average amount of clothing.

tion. The fact that the majority (about three-fifths) owned automobiles, or trucks or busses, made raincoats less necessary. The men, grown boys, and high school boys had rubber boots desirable for farm work during bad weather, as well as for fishing and hunting. The other groups with the exception of grown girls and high school girls did not own rubber footwear. Grown girls and high school girls may have owned rubbers more often, because the soles of their shoes were thinner than those of their mothers and younger brothers and sisters.

Most school boys, grown boys, and men did not have special garments for nightwear. This is one place where these wardrobes might need improvement. A change of garments at night might mean greater cleanliness especially if laundry is done only once a week. Loose fitting, comfortable garments made especially for nightwear allow the wearer to get the best kind of rest.

As will be noted, the number of garments on hand is divided into homemade and ready-made, for women and girls, preschool boys and infants. Many garments for these groups are usually made at home, but for the other boys and the men the practice was to buy everything ready-made. Costs for the homemade garments include money spent for materials and findings, not putting a value on the time it took the homemaker to do the sewing. As had been stated before, costs listed in the tables are not what the families actually spent on clothing, but what similar garments, material and findings would cost this fall of 1942.

Next in the tables is shown the number of each kind of garment which is purchased in 1 year (replacement during year). Of course, one cannot buy one-third of a coat or cap, but one can buy a coat or a cap every 3 years. That is what the fractions mean. The year for buying garments which are not re-

placed yearly depends on what other needs there are for the individual and for the whole family. In a few cases a choice of garments is given. Then in the total is shown the minimum and maximum cost for the year's clothing purchases.

When garments not purchased for the individual were found in the majority of the wardrobes or typical supplies of the group, they were added at the bottom of the table in a footnote. Garments not purchased included new gifts, second-hand gifts (that had been used before they were given), hand-downs, and garments made from old materials or sacks, all articles for which there was no cost.

TYPICAL WARDROBES OF MEN AND BOYS

Clothing Supplies of Men

Typical clothing supplies for men included 20 different items: 2 kinds of headwear, 2 kinds of wraps, a wool suit, cotton trousers and overalls, cotton work shirts and other cotton skirts, heavy and lightweight cotton underwear, cotton socks for everyday, rayon socks for dress, work and dress shoes, rubber boots, handkerchiefs, ties, belts and work gloves (table 1 and figure 1).

Headwear consisted of two felt hats and either a straw field hat or a cap. One felt hat was bought each year and saved for "best." The one from the year before was used for everyday. If a straw field hat was worn for work during the summer, it lasted for 1 year, while a cap was replaced only once in 3 years.

As a heavy wrap for best, a jacket or an overcoat was chosen. The jacket might be of wool, corduroy or leather, with prices ranging from \$3.50 for the wool and corduroy to \$7.50 for the leather. They were replaced every 3 years, while overcoats lasted 10 years. No doubt jackets were used more often



Figure 1. Typical clothing supplies of men showing kind and number of garments on hand.

for knockabout and overcoats were saved for special occasions and used less.

Another wrap, worn for work and sometimes for knockabout, might be one of the following: a lined jumper (denim jacket), an unlined jumper, a part wool sweater or a wool sweater. Lined jumpers, with an average cost of \$2.00, and wool sweaters, \$3.50, would usually last 4 years. A part wool sweater, costing \$1.80, would last three years. The unlined jumper, at \$1.10, would be worn 2 years. Thus, figuring on the cost over several years, the lined jumper would be the most economical purchase, provided, of course that it was used for 4 years. It may take a good deal of mending before that time is up, but a good homemaker always knows how to use pieces of old overalls to cover up worn places on sleeves and such.

Wool suits were generally bought every

fifth year. They were moderately priced, had one pair of trousers, and were worn for social occasions during most of the year. During the warmest weather, cotton trousers and lightweight cotton shirts were worn. Men usually had three pairs of cotton trousers and three lightweight cotton shirts, two of each being purchased each year.

For work, two pairs of overalls and three cotton shirts were kept on hand, all bought during the year. Sometimes, of course, old cotton or wool trousers and suit coats were worn for work. Rubber boots and work gloves were also part of the work attire of these men.

There were different types of footwear, for dress and for work. Dress shoes (or "slippers" as they were often called) lasted 2 years and were generally worn with rayon socks. Work shoes usually lasted only 1 year and were worn with

Table 1. Typical wardrobes of farmers, showing number and costs of garments on hand and of year's replacements

Garment*	Garments on hand		Replacements during year	
	Number**	Cost per garment	Number	Total cost
		dollars		dollars
Hats, felt	2	2.14	1	2.14
Hats, straw, or cap, homewear	1	.69	1/2	.35
Heavy jacket, leather, wool, or corduroy, ...	1	5.49	1/3	1.83
or overcoat		12.75	1/10	1.28
Suit, wool	1	18.95	1/5	3.79
Jumper, cotton or wool, or sweater	1	2.69	1/3	.90
Trousers, cotton	3	1.59	2	3.18
Overalls	2	1.26	2	2.52
Shirts, heavy cotton	3	.89	3	2.67
Shirts, other cotton	3	1.39	2	2.78
Union suits, heavy cotton knit	2	.98	1	.98
Underwear, lightweight, either one piece or	2	.50	1	.50
shirts and shorts		(.25 each)		
Socks, cotton for everyday	3	.18	3	.54
Socks, rayon	3	.25	3	.75
Shoes, work	1	2.75	1	2.75
Shoes, dress	1	3.35	1/2	1.68
Boots, rubber	1	2.98	1/4	.75
Handkerchiefs	6	.08	5	.40
Ties	2	.79	1	.79
Belts	1	.89	1/4	.23
Gloves, work	1	.55	1	.55
Total cost for year				29.53 - 30.08

*These men had in addition 1 cotton shirt, 3 handkerchiefs and 2 ties received as gifts.

**All clothing ready-made.

cotton socks (or no socks during warm weather.)

Men economized on supplies of underwear. Four sets, two heavy and two light (either one piece or sets of undershirts and shorts) were kept on hand, one suit of each kind being bought each year. Boys preferred the sets of undershirts and shorts, while many of the men used one-piece underwear.

A brief description of the costumes usually worn by men for various occasions follows:

For Work

An old felt hat, or a straw hat or cap.
A sweater, jumper or jacket.
Blue denim overalls and heavy cotton shirts.
Work shoes, cotton socks.
Work gloves and boots, when needed.

For Town

Felt hat or a cap.
A heavy jacket.
Cotton trousers and shirt.
Dress shoes, rayon socks.

For Church

Felt hat.

Overcoat, or heavy jacket.

Wool suit (or cotton trousers and shirt in warm weather.)

Dress shoes, rayon socks.

Clothes worn for work are older and rougher than those worn for town. Best and most expensive clothes are worn for church. The smaller the town, the more alike are clothes for work and for town; the larger the town the more alike are clothes for town and for church. Best clothes and church clothes (or "Sunday clothes") are the same (See figures 5, 6 and 7 for costumes of men on various occasions.)

Clothing Supplies of Grown Boys

Typical clothing supplies for grown boys included 20 different items: 2 kinds of headwear, 1 kind of wrap, a wool suit, both wool and cotton trousers, overalls, cotton work shirts and other cotton shirts, undershirts and shorts, cotton socks for everyday and rayon socks for dress, work and dress shoes, rubber

Table 2. Typical wardrobes of grown boys, showing number and costs of garments on hand and of year's replacements.

Garment*	Garments on hand		Replacements during year	
	Number**	Cost per garment	Number	Total cost
		dollars		dollars
Hats, felt	1	1.95	1	1.95
Hats, straw, or cap, homewear	1	.69	1	.69
Jacket, leather or other	1	4.98	1/4	1.25
Suit, wool	1	16.75	1/2	8.38
Trousers, cotton	3	1.59	2	3.18
Trousers, wool or part wool	2	2.94	1	2.94
Overalls	2	1.26	2	2.52
Shirts, heavy cotton	2	.79	2	1.59
Shirts, other cotton	3	.98	2	1.96
Undershirts	3	.25	3	.75
Shorts	3	.25	3	.75
Socks, heavy cotton	3	.18	3	.54
Socks, rayon	3	.25	3	.75
Shoes, work	1	2.49	1	2.49
Shoes, dress	2	3.48	2	6.96
Boots, rubber or leather	1	4.49	1/2	2.25
Handkerchiefs	5	.08	5	.40
Ties	3	.79	2	1.59
Belts	2	.59	1	.59
Gloves, work	1	.55	1	.55
Total cost for year				40.87

*Had in addition 3 handkerchiefs, 2 ties, 1 belt and 2 pairs of socks received as gifts.

**All clothing ready-made.

boots, handkerchiefs, ties, belts, and work gloves (table 2). Their clothing differed from their fathers' in quantity on hand and amount bought in a year's time, rather than in type of garment. The men, for instance, wore their wool suits for 5 years, the grown boys for 2 years. Grown boys had two pairs of dress shoes a year; men had a new pair of dress shoes every other year.

The total cost of replacement during the year for grown boys' clothing (\$40.87) was greater than that for any of the other 10 groups. The number of social activities in which they participated was greater, too. Such activities included attendance at preaching, young people's unions, Sunday School, singings, picnics, ball-games, home entertainments, and the like. They participated in social activities on an average of four times a week. Men had an average social participation of three times a week. The total cost

of replacement of men's clothing during the year was about \$30.

A brief description of the costumes usually worn by grown boys for various occasions follows:

For work

Cap or straw hat.
Jacket.
Blue denim overalls and heavy cotton shirts.
Work shoes, cotton socks.
Work gloves and boots, when needed.

For Town

Felt hat or cap.*
Jacket.
Trousers and shirt.
Dress shoes, rayon socks.

For Church

Felt hat.*
Wool suit, cotton shirt (Trousers and shirt in warm weather).
Dress shoes, rayon socks.

*The grown boy often goes bareheaded. Hats serve as protection in bad weather.

Clothing of High School Boys

Typical clothing supplies for high school boys included 18 different

Table 3. Typical wardrobes of high school boys, showing number and costs of garments on hand and of year's replacements.

Garment*	Garments on hand		Replacements during year	
	Number**	Cost per garment	Number	Total cost
		dollars		dollars
Hats, felt	1	1.95	1/2	.97
Hats, straw, or cap, homewear	1	.59	1	.59
Jacket, wool or leather	1	4.98	1/2	2.49
Suit, wool	1	13.50	1/2	6.75
Trousers, cotton	3	1.39	2	2.78
Overalls	2	1.10	1	1.10
Shirts, heavy cotton	2	.79	2	1.58
Shirts, other cotton	3	.98	2	1.96
Undershirts	3	.25	3	.75
Shorts	3	.25	3	.75
Socks, cotton	2	.18	2	.36
Socks, rayon	3	.25	3	.75
Shoes, work	1	2.19	1	2.19
Shoes, dress	1	3.35	1	3.35
Boots, rubber or leather	1	3.69	1/3	1.23
Handkerchiefs	4	.08	4	.32
Ties	2	.49	2	.98
Belts	2	.45	1	.45
Total cost for year				29.35

*These boys had in addition 1 pair of cotton trousers, 1 shirt, 2 handkerchiefs, 3 ties and 1 belt made from old materials or hand-downs or gifts, all garments for which there was no cost.

**All clothing ready-made.



Figure 2. Garments in wardrobes of high school boys showing kind and number of garments on hand.

items: 2 kinds of headwear, 1 kind of wrap, a wool suit, cotton trousers, overalls, cotton work shirts and other cotton shirts, undershirts and shorts, cotton socks for everyday and rayon socks for dress, work and dress shoes, rubber boots, handkerchiefs, ties, and belts (table 3 and figure 2).

The high school boy had fewer work clothes and not so many dress clothes as did the grown boy. Because he attended school he had less need of work shirts, overalls, and work gloves. He did not wear overalls to school as did his younger brother (figure 8). The high schools were often located in town, and town boys do not wear overalls to school. The high school boy dressed to meet his social setting—the town.

High school boys had fewer dress clothes than did grown boys and paid somewhat less for these garments. High school boys, of course, less often had money of their own. They had one pair of dress shoes to the grown boys two. High school boys participated on an average in three or four social activities a week. This is less than the participation of the older group.

The clothing of the high school boy was more similar to that of his grown brother and father than to that of his grammar school brother. His wardrobe contained a wool suit and boots—marks of growing up. The total cost of replacement of his clothing during the year was about the same as that of his father.

A brief description of the costumes usually worn by high school boys for various occasions follows:

For Farm Work

Cap or straw hat.
Jacket.
Overalls.
Heavy cotton shirt.
Work shoes, cotton socks.
Boots, when needed.

For School and Town

Felt hat or cap.*
Jacket.
Trousers and shirt.

Work and dress shoes, rayon and cotton socks.

For Church

Felt hat.*

Wool suit, cotton shirt (trousers and shirt in warm weather).

Dress shoes, rayon socks.

*The high school boy often goes bareheaded. Hats serve as protection in bad weather.

Clothing of Grammar School Boys

Typical clothing supplies for grammar school boys were less than for their fathers or older brothers. Their wardrobes included 14 garments: 1 kind of headwear—a cap—2 kinds of wraps, cotton and other trousers, overalls, heavy and light cotton shirts, heavy and lightweight union suits, cotton socks for all occasions, work or school shoes and dress shoes and belts. Their ties and handkerchiefs were received as gifts (table 4).

The clothing supplies of grammar school boys were similar to those of men, grown boys and high school boys, in that they were purchased ready-made. They were, however, more limited in variety than those of the older group. Grammar school boys did not own a wool suit or boots. Some of the boys "wished they did own a suit," but this desire was not usually granted for it was thought that purchasing the first wool suit could be delayed until high school days when the boy would go out with the girls. The fact that they outgrow clothing so rapidly deterred many parents from making this purchase. Again, grammar school boys are "rough on clothing."

That clothing standards are different for grammar school and high school boys is indicated by the fact that social participation of grammar school boys was about the same as for high school boys: 3 to 4 times a week. They could participate as often with less costly wardrobes. Total cost of replacing their clothing averaged only \$15 a year.

Perhaps the greatest difference in the clothing of grammar school and high

Table 4. Typical wardrobes of grammar school boys, showing number and costs of garments on hand and of year's replacements.

Garment*	Garments on hand		Replacements during year	
	Number**	Cost per garment	Number	Total cost
		dollars		dollars
Cap	1	.69	1	.69
Jacket, wool or corduroy	1	2.19	1/2	1.10
Sweater, or other wrap	1	1.75	1/2	.88
Trousers, cotton	1	1.15	1	1.15
Trousers, other	1	2.05	1/2	1.03
Overalls	3	.86	2	1.72
Shirts, heavy cotton	2	.65	2	1.30
Shirts, other cotton	2	.72	2	1.44
Union suits, heavy	2	.67	1	.67
Union suits, lightweight, one piece or shorts and shirts	2	.36	2	.72
		(.18 each)		
Socks, cotton	4	.18	4	.72
Shoes, dress	1	1.89	1	1.89
Shoes, school or work	1	1.84	1	1.84
Belts	1	.45	1/2	.23
Total cost for year				15.38

*These boys had in addition 1 handkerchief, 1 tie, received as gifts.

**All clothing ready-made.

school boys is in their school clothing (figure 8). The grammar school boy usually wears overalls to school; his high school brother wears trousers. Overalls are the work costume of farmers and all farm boys would ordinarily wear this costume to school. But, when they attend schools with a number of sons of business, professional and clerical workers who wear trousers to school, they follow this practice also. More high schools than grammar schools attended by farmers' children are located in urban areas. Since grammar school boys are less clothes conscious than high school boys, perhaps they care less whether they wear overalls or trousers to school. Overalls are not ordinarily worn for dress, although some of the younger grammar school boys do wear corduroy overalls for dress.

The fact that many consolidated schools are in town and that children of rural families go to such schools may mean that lack of the "accepted" clothing causes some children not to go to or finish high school.

A brief description of the costumes

usually worn by grammar school boys for various occasions follows:

For Farm Work, or At Home

Cap.*
Sweater.
Overalls.
Cotton shirt.
Work or school shoes and cotton socks.**

For School or Town

Cap.*
Sweater or jacket.
Overalls (trousers and shirt sometimes).
School or dress shoes,** cotton socks.

For Church

Cap.*
Jacket.
Trousers and cotton shirt.
Dress shoes, cotton socks.

*Go bareheaded most of the time. Cap serves as protection in bad weather.

**Sometimes go barefooted to school or town; often go barefooted at home, during warm weather. This is probably an excellent practice from the standpoint of health and should be encouraged.

Clothing of Preschool Boys

Typical clothing supplies for preschool boys (2 through 5 years of age) included a cap, a wrap (jacket or sweater), wash suits, overalls and coveralls, shirts (light

Table 5. Typical wardrobes of preschool boys, showing number and costs of garments on hand and of year's replacements.

Garment*	Garments on hand		Cost of Garment		Replacement during year		All
	Home-made	Ready-made	Home-made	Ready-made	Home-made	Ready-made	
	number		dollars		number		dollars
Cap, heavy	0	1	0	.42	0	1	.42
Jacket (wool or corduroy) or sweater	0	1	0	1.19	0	1	1.19
Wash suits	0	2	0	.85	0	1	.85
Overalls, corduroy	0	1	0	.98	0	1	.98
Coveralls, cotton	0	1	0	.54	0	1	.54
Overalls, denim	0	2	0	.56	0	2	1.12
Shirts, cotton (1 light, 1 heavy)	2	0	.19	0	2	0	.38
Union suits, cotton knit	0	2	0	.55	0	1	.55
Pajamas, flannelette	1	0	.58	0	1	0	.58
Pajamas, lightweight cotton	1	0	.58	0	1	0	.58
Socks, cotton	0	3	0	.15	0	3	.45
Shoes	0	1	0	1.19	0	1	1.19
Total cost for year							8.83

*These boys had in addition 1 pair of overalls, 1 shirt, 1 pair of heavy unions, 1 pair of socks, made from old materials or hand-downs or gifts, all garments for which there was no cost.

and heavy weight), union suits, pajamas, shoes and socks (table 5).

The clothing supply of this group differed greatly from that of grown boys and school boys. It was more limited in quantity and contained more home-made and more hand-downs than did clothing of other groups. Because preschool boys were at home more than the older boys, they could manage with fewer wraps and fewer shoes than older boys. In fact, many of them went barefooted the greater part of the year. The yearly replacement cost of their clothing was around \$9.00.

No information was obtained concerning the social participation of preschool boys, as their social participation depended in the main on the social participation of their mothers. Women, averaging an attendance at two to three activities a week, participated less than did men.

Clothing of men and boys was, as a rule, ready-made, but wardrobes of the majority of preschool boys contained shirts and pajamas made at home. Such garments can be made at home very easily, oftentimes from scraps of material. A ready-made shirt is perhaps one mark of

coming of age, school age.

Preschool boys more often had hand-downs and garments made from old materials than did the other groups. Their clothing required less material than did clothing for their older brothers. The unworn part of an old garment of their fathers would furnish enough material to make a new garment for them.

One type of garment which preschool boys owned that was not owned by men and older boys was nightwear. This may be a carry-over from infancy when frequent changes are thought to be more necessary.

A brief description of the costumes usually worn by preschool boys for various occasions follows:

Home Clothes

Sweater.
Blue denim overalls or coveralls.
Shoes* and socks.

Dress Clothes

Cap.
Jacket or sweater.
Corduroy overalls (winter).
Wash suits (summer).
Shoes* and cotton socks.

*In warm weather go barefooted most of the time.

TYPICAL WARDROBES OF WOMEN AND GIRLS

Farm Homemakers' Clothing

Typical clothing supplies for farm women included 20 different items: 2 kinds of headwear; 2 kinds of wraps, rayon, cotton best and cotton house dresses, aprons, cotton and rayon slips, lightweight and heavyweight gowns, cotton and rayon panties, cotton and rayon hose, dress and work shoes, handkerchiefs, and purses (table 6 and figure 3).

The number of garments on hand and frequency of replacement of garments did not differ greatly for men and women; especially was this true of work garments. Both had a new pair of work shoes each year. The man had two new pairs of overalls each year, the woman two new house dresses. The man had work gloves, the woman did not. Much of the farm work done by the woman can be best

done without gloves. For a few of her tasks, however, she really needs gloves, as for instance, pruning berry vines, and for these, she might pick up a pair of her husband's or older son's gloves. Aprons were also a part of the work equipment of women. These were generally made from sacks or old material and involved no money cost.

It is interesting to note that the most expensive garment in the wardrobes of men and women was replaced at the same frequency, every 5 years. These garments were the wool suit of men and the wool coat of women.

The greatest difference in the wardrobes of men and women was in the total cost of replacement. The cost was for women \$19.37 (table 6); for men about \$30 (table 1). There were at least three reasons for this difference in cost. In the first place, wardrobes of women contained a number of homemade garments,

Table 6. Typical wardrobes of farm homemakers, showing number and costs of garments on hand and of year's replacements.

Garment*	Garments on hand		Cost of Garment		Replacement during year		All
	Home-made	Ready-made	Home-made	Ready-made	Home-made	Ready-made	
	number		dollars		number		dollars
Hat, felt	0	1	0	1.95	0	1/3	.65
Hat, straw	0	1	0	1.29	0	1/2	.65
Coat, heavy without fur	0	1	0	9.98	0	1/5	2.00
Sweater or jacket	0	1	0	2.19	0	1/4	.55
Dresses, rayon	0	2	0	2.98	0	1	2.98
Dresses, cotton best	2	0	.80	0	1	0	.80
Dresses, cotton house	3	0	.65	0	2	0	1.30
Slips, cotton	2	0	.35	0	1	0	.35
Slips, rayon	0	1	0	.98	0	1	.98
Nightgowns, cotton flannel	1	0	.65	0	1/2	0	.33
Nightgowns, lightweight cotton	1	0	.65	0	1/2	0	.33
Panties, cotton	0	2	0	.33)			
Panties, rayon knit	0	2	0	.39)		3	1.08
Hose, rayon	0	2	0	.65	0	2	1.30
Hose, cotton	0	2	0	.23	0	2	.46
Shoes, dress	0	1	0	2.59	0	1	2.59
Shoes, work	0	1	0	2.29	0	1	2.29
Handkerchiefs	0	6	0	.08	0	5	.40
Purses	0	1	0	1.00	0	1/3	.33
Total cost for year							19.37

*These women had in addition 1 rayon dress, 1 cotton house dress, 2 aprons, 1 cotton slip, 4 handkerchiefs and 1 pair of hose made from sacks or old materials or hand-downs or gifts, all garments for which there was no cost.



Figure 3. Garments in wardrobes of farm homemakers showing kind and number of garments on hand.

which generally involve a lower money cost than do ready-made garments. All the cotton dresses and slips owned by women were made at home. Summer and winter nightgowns were also homemade. The money cost of no homemade garment was as much as one dollar, and most of the homemade garments cost considerably less than a dollar.

Another explanation for lower cost of women's wardrobes than of men's was the more frequent purchase of headwear and outer garments, such as jackets or sweaters by men. The other reason for the lower cost of replacement of wardrobes of women was the greater number of garments without money cost in wardrobes of women, especially more gifts, new or second-hand. Women ordinarily get more gifts from their relatives or grown children living away from home than do men. Women replaced their dress shoes more often than did men, but as men paid more per pair, the total cost of shoes for women in the typical wardrobe was only a little greater.

A brief description of the costumes usually worn by women for various occasions follows:

For Work

- Sweater or jacket.
- Cotton house dress.
- Work shoes
- Cotton hose.
- Apron as needed.

For Town and Church

- Felt or straw hat.
- Coat.
- Rayon or cotton street dress.
- Dress shoes.
- Rayon hose.

There is little difference in costumes of women for town and for church, although cotton dresses are more often worn to town than to church. Women often go to town bareheaded, while hats are worn to church (figures 5, 6 and 7).

Clothing Supplies of Grown Girls

Typical clothing supplies for grown girls included 26 different items: 2 kinds of headwear, a heavy coat, 2

sweaters, a skirt and blouse, rayon, cotton best and cotton house dresses, cotton and rayon slips, brassieres, nightgowns and pajamas, cotton and rayon panties, 4 types of shoes, galoshes, rayon hose, socks, handkerchiefs, and purses (table 7).

The wardrobes of grown girls were larger than were those of all other groups except infants. They contained most frequently 62 garments. Their yearly cost of clothing replacement was considerably less than that of grown boys (\$31 as compared with \$41). One reason for this is that the wardrobes of grown girls had a number of homemade garments. Eight of their nine dresses were homemade. Their blouses and skirts as well as their cotton slips, gowns, and pajamas were made at home.

The most expensive garment in the wardrobes of boys, a woolen suit, was replaced every other year. A heavy woolen coat, the most expensive article in the wardrobes of grown girls was replaced every fourth year. Adult farm girls living at home have less money of their own for clothing than do adult farm boys. It is not customary for farmers to give a portion of the crop or pay regular wage to their daughters as they often do their sons, nor do girls have as much opportunity for part-time work. Thus, grown boys have more to spend on clothing than do grown girls. Even then, grown girls spend more for clothing than do other female groups. This in spite of the fact that the number of social activities in which they engage during a week—an average of three—is less than the average number engaged in by their younger school-going sisters. Clothing standards demand more for a young lady ready for marriage than for school girls.

Clothing standards are also more demanding for grown girls than for married women. Although women engaged in nearly as many social activities as



Figure 5. A farm family in their work clothes.

grown girls, they had less clothing and wore their garments for longer periods. Grown girls had new felt and straw hats each year. Women had a new felt hat every third year and a new straw hat every other year. Women had two new pairs of shoes a year. Grown girls had three pairs. Women had a new sweater every fourth year; grown girls every year. Women had four dresses they wore for best; grown girls had six.

A brief description of the costumes usually worn by grown girls for various occasions follows:

For Work

Sweater.
Cotton house dress.*
Oxfords, socks.

For Town

Felt or straw hat.**
Wool coat or sweater, skirt and blouse.
Cotton street dress or rayon dress.
Shoes, low or medium heels, and socks.

For Church

Felt or straw hat.

Wool coat or sweater, skirt and blouse.

Rayon or cotton dress.

Shoes, high heels.

Rayon hose.

*Inventories of girls with more garments and more expensive garments than the average contained slack suits. The middle group oftentimes wore the overalls of the men of the family when doing farm work. At the present time, with the war emphasis on work garments for women, wardrobes of this middle group might show slack suits.

**Often go bareheaded.

Dress for town was about the same as for church or best, except best clothes were more likely to include the newest rayon or cotton dress and high heeled shoes.

Clothing of High School Girls

Typical clothing supplies for high school girls included 17 items: a coat, skirts and blouses, a sweater, cotton and rayon dresses, cotton and rayon slips, brassieres, pajamas, rayon panties,

Table 7. Typical wardrobes of grown girls, showing number and costs of garments on hand and of year's replacements.

Garment*	Garments on hand		Cost of Garment		Replacement during year		All
	Home-made	Ready-made	Home-made	Ready-made	Home-made	Ready-made	
	number		dollars.		number		dollars
Hat, felt	0	1	0	1.35	0	1	1.35
Hat, straw dress	0	1	0	1.29	0	1	1.29
Coat, heavy without fur	0	1	0	9.98	0	1/4	2.50
Skirt, rayon	1	0	1.50	0	1	0	1.50
Sweater, wool	0	1	0	1.49	0	1/2	.74
Sweater, cotton or part wool	0	1	0	1.10	0	1/2	.55
Blouse, rayon, satin or crepe	1	0	1.30	0	1	0	1.30
Dresses, rayon	2	1	2.00	2.98	1	1/2	3.49
Dresses, cotton best	3	0	.70	0	2	0	1.40
Dresses, cotton house	3	0	.65	0	2	0	1.30
Slips, cotton	3	0	.35	0	3	0	1.05
Slips, rayon	0	2	0	.79	0	1	.79
Brassieres	0	2	0	.25	0	2	.50
Nightgowns, cotton flannel	1	0	.65	0	1	0	.65
Pajamas, cotton print	1	0	.65	0	1/2	0	.33
Panties, cotton knit	0	2	0	.29	0	2	.58
Panties, rayon knit	0	4	0	.30	0	4	1.20
Oxfords, low heels	0	1	0	1.98)			
Shoes, summer, low or medium heels	0	1	0	2.45)	0	3	6.68
Shoes, dark, high heels	0	1	0	2.59)			
Shoes, other	0	1	0	1.98)			
Galoshes	0	1	0	1.19	0	1	1.19
Hose, rayon	0	1	0	.65	0	1	.65
Socks	0	6	0	.17	0	6	1.02
Handkerchiefs	0	6	0	.08	0	5	.40
Purses	0	2	0	.85	0	1	1.85
Total cost for year							31.31

*These women had in addition 1 brassiere, 1 rayon slip, 1 gown or pair of pajamas, 3 rayon panties, 4 handkerchiefs, and 1 pair of hose received as gifts.

oxfords, dark and light dress shoes, socks, galoshes and handkerchiefs (table 8).

The high school girl had more clothes than her mother, but not as many as the grown girl. Her wardrobe contained in the majority of cases 50 garments, that of the mother 43. More of her substantial clothing consisted of hand-downs and gifts than did that of her mother or her out-of-school sister. Because she was smaller, some of the garments of these as well as other relatives could be cut down and made for her. This explains the lower replacement cost of her wardrobe per year, \$23.

Another difference between the wardrobe of the high school girl and that

of her mother was in kind of garments. Wardrobes of women contained hats, night-gowns, cotton panties, both cotton and rayon hose, and a purse, not in wardrobes of high school girls. Wardrobes of high school girls contained skirts and blouses, brassieres, pajamas, socks, galoshes, not in wardrobes of women.^{3/} It would seem that even styles of underwear have social value for the high

^{3/} Only 43 percent of the women in this middle group owned brassieres, 49 percent corsets and girdles. See "Clothing Supplies of Socially Participating White Farm Families of Mississippi," Alice Bowie and Dorothy Dickens, Miss. Agri. Exp. Sta. Tech. Bull. No. 30, (1942), pg. 30.

Table 8. Typical wardrobes of high school girls, showing number and costs of garments on hand and of year's replacements.

Garment*	Garments on hand		Cost of Garment		Replacement during year		All
	Home-made	Ready-made	Home-made	Ready-made	Home-made	Ready-made	
	number		dollars		number		dollars
Coat, heavy without fur.....	0	1	0	7.89	0	1/2	3.95
Skirt, rayon	1	0	1.15	0	1	0	1.15
Sweater, wool or part wool.....	0	1	0	1.29	0	1	1.29
Blouse, cotton broadcloth	1	0	.35	0	1/2	0	.18
Dresses, rayon	1	1	1.80	2.19	1/2	1/2	2.00
Dresses, cotton	5	1	.70	1.00	3	1	3.10
Slips, cotton broadcloth	2	0	.30	0	1	0	.30
Slips, rayon	0	2	0	.69	0	2	1.38
Brassieres	0	2	0	.25	0	2	.50
Pajamas, cotton print	2	0	.60	0	1	0	.60
Panties, rayon knit	0	4	0	.30	0	3	.90
Socks	0	6	0	.17	0	6	1.02
Oxfords, low heels, dark	0	1	0	1.98	0	1	1.98
Oxfords, low heels, light	0	1	0	1.98	0	1	1.98
Other shoes, medium heels, dress.....	0	1	0	2.29	0	1	2.29
Galoshes	0	1	0	1.19	0	1/2	.60
Handkerchiefs	0	6	0	.08	0	6	.48
Total cost for year							23.40

*These girls had in addition 1 sweater, 1 rayon dress, 1 cotton dress, 1 skirt, 1 blouse, 2 handkerchiefs, 1 brassiere, 1 pair rayon panties and 1 pair of socks made from old materials or hand-downs or gifts, all garments for which there was no cost.

school girl, pajamas and rayon panties being preferred to nightgowns and cotton panties.

The high school girl, averaging an attendance at three to four social activities per week, participated more in social activities than did her mother. The average for women was one less activity per week. For high school girls there were, of course, many activities in connection with the school, such as clubs and ball games, in addition to church and agricultural clubs attended by other members of the family.

The clothing supplies of high school girls were not as varied as those of grown girls, but the replacement of the more substantial garments was as frequent or more so. They had about the same number of new dresses, sweaters and new shoes each year as did grown girls. They had a new coat every other year, while grown girls had a new one every 4 years. This was not only because the

high school girls wore their coats more, but because they outgrew them.

A brief description of the costumes usually worn by high school girls for various occasions follows:

For Home or Farm Work

Sweater.
Cotton dress.*
Oxfords and socks.

For School or Town

Coat or sweater, blouse, skirt.
Cotton dress (rayon dress sometimes).
Oxfords and socks.

For Church**

Coat or sweater, blouse, skirt.
Rayon or cotton dress.
Dress shoes and socks.

*Sometimes used the overalls of men of the family for farm work.

**The more reduced the family circumstances or the larger the town in which the school is located, the more likely are school or town and church or best clothes to be the same.

Grammar School Girls' Clothing

Typical clothing supplies for grammar school girls included 15 items: a cap,



Figure 6. This family is dressed for church.

Table 9. Typical wardrobes of grammar school girls, showing number and costs of garments on hand and of year's replacements.

Garment*	Garments on hand		Cost of Garment		Replacement during year		All
	Home-made	Ready-made	Home-made	Ready-made	Home-made	Ready-made	
	number		dollars		number		dollars
Cap	0	1	0	.89	0	1/2	.45
Coat, heavy without fur.....	0	1	0	4.98	0	1/2	2.49
Sweater, wool or part wool	0	1	0	1.29	0	1	1.29
Dress, rayon	1	0	1.25	0	1	0	1.25
Dress, cotton	5	1	.45	1.00	4	1	2.80
Skirt, cotton	1	0	.65	0	1	0	.65
Slip, cotton broadcloth	2	0	.30	0	2	0	.60
Slip, rayon	0	1	0	.60	0	1	.60
Pajamas, cotton flannel	1	0	.55	0	1/2	0	.27
Pajamas, print or broadcloth	1	0	.50	0	1/2	0	.25
Panties, cotton	1	1	.11	.25	1	1	.36
Panties, rayon knit	0	2	0	.20	0	2	.40
Socks	0	5	0	.17	0	5	.85
Oxfords, low heels	0	2	0	1.98	0	2	3.96
Total cost for year							16.23

*These girls had in addition 1 rayon dress, 1 cotton dress, 1 pair of cotton panties, and 2 handkerchiefs made from old materials or hand-downs or gifts, all garments for which there was no cost.



Figure 4. Garments in wardrobes of grammar school girls showing kind and number of garments on hand.

a coat, a sweater, rayon and cotton dresses, a skirt, cotton and rayon slips, light and heavy pajamas, cotton and rayon panties, oxfords, socks and handkerchiefs (table 9 and figure 4).

The wardrobes of grammar school girls were smaller than those of high school girls. They had 9 dresses, while high school girls had 10. They had one sweater to the high school girl's two, one skirt to the high school girl's two, two pairs of shoes to the high school girl's three pairs. Some of the grammar school girls, especially the younger ones went barefooted at home during the summer time and thus reduced their need for shoes. The social participation of the two groups of girls was the same, both attending on an average three to four so-

cial activities a week, but clothing demands for the younger girls seemed less.

Home-sewing played an important part in the wardrobes of grammar school girls, as it did of high school girls; their skirts, dresses (except one cotton dress), cotton slips, and pajamas were all homemade. Also included in their clothing supply were cotton panties made from new and old material (sometimes sacks, or scraps left over from dresses).

Wardrobes of grammar school girls resembled those of grammar school boys in some respects. The total cost of clothing replacement during the year was about the same for grammar school girls (\$16.23) and grammar school boys (\$15.38). The number of garments owned by both groups was about the same. In



Figure 7. This farm family, husband, wife, high school daughter, and grammar school sons are dressed for town.

both cases the heavy wrap was replaced every other year. Both had two new pairs of shoes each year. The boys had one less pair of socks than the girls, but they went barefooted more.

Almost all articles of clothing for grammar school girls were worn for all occasions away from home, such as coats, sweaters, and skirts and dresses, cotton as well as rayon. The costumes which they wore at various occasions were:

For Home or Farm Work

Sweater
Cotton dress.*
Oxfords and socks.**

For School or Town

Cap or beret.***
Coat.
Sweater and skirt.
Cotton dress (rayon dress sometimes).
Oxfords and socks.

For Church

Cap or beret.***
Coat.
Sweater and skirt.
Rayon or cotton dress.
Oxfords and socks.

*Sometimes used the overalls of brothers for farm work.

**Go barefooted oftentimes in warm weather.

***Cap serves as protection in bad weather.

Clothing Supplies of Preschool Girls

Typical clothing supplies for preschool girls (2 through 5 years of age) included 13 different items: a cap or beret, a coat, a wool sweater, rayon and cotton dresses, overalls or coveralls, slips, union suits, undershirts, cotton and rayon panties, shoes and socks (table 10).

The wardrobes of these preschool girls contained more hand-downs and garments made from old materials or left-over scraps than did the other groups. This explains why the cost of yearly replacement of their clothing was so low—\$6.55. The main outer garments which they wore for best had been made from other garments requiring time and work from their mothers, but no outlay of money.

The difference between the clothing of preschool and grammar school girls was not so marked in number as in type of garments. Preschool girls wore coveralls or overalls frequently; grammar school girls did not. Preschool girls had union suits, shirts and long sleeved flannel slips in their wardrobes. Such articles of clothing were not found usually

Table 10. Typical wardrobes of preschool girls, showing number and costs of garments on hand and of year's replacements.

Garment*	Garments on hand		Cost of Garment		Replacement during year		All
	Home-made	Ready-made	Home-made	Ready-made	Home-made	Ready-made	
	number		dollars		number		dollars
Cap or beret	0	1	0	.39	0	1/2	.20
Sweater, wool	0	1	0	1.39	0	1/2	.70
Dresses, cotton	4	1	.30	.79	3	1	1.69
Overalls or coveralls	0	1	0	.60	0	1/2	.30
Slips, lightweight cotton and flannelette	3	0	.21	0	3	0	.63
Union suits, cotton knit	0	1	0	.49	0	1	.49
Undershirt, cotton knit	0	1	0	.25	0	1	.25
Panties, cotton	0	2	0	.15	0	2	.30
Panties, rayon knit	0	1	0	.19	0	1	.19
Oxfords	0	1	0	1.29	0	1	1.29
Socks and stockings, cotton	0	3	0	.17	0	3	.51
Total cost for year							6.55

*These girls had in addition 1 cap or beret; 1 coat, 3 dresses, 2 cotton and 1 rayon; 1 pair of overalls or coveralls, 1 pair of panties made from old materials or hand-downs or gifts, all garments for which there was no cost.



Figure 8. This high school boy and girl and grammar school boy and girl are wearing the typical costumes of their groups.

in wardrobes of grammar school girls. The garments probably were used for sleeping as well as for undergarments which would explain the lack of sleeping garments listed as such. The suits of underwear were one-piece suits with short legs.

Preschool girls had two kinds of clothing: clothing they wore at home and clothing they wore away from home or for best. A brief description of these costumes follows:

Home Clothes

Sweater.
Overalls or coveralls or cotton dress.
Shoes and socks.*

Dress Clothes

Cap or beret,**
Coat.
Cotton or rayon dress.
Shoes and socks.

*In warm weather go barefooted most of the time.

**Go bareheaded in good weather.

Clothing Supplies of Infants

Typical clothing supplies for infants (boys and girls less than 2 years of age) included two caps, two wraps (sweaters, jackets, or coats), dresses or suits, overalls or coveralls, cotton slips, undershirts, nightgowns, kimonos or robes, diapers, socks, shoes or booties (table 11).

While infants had less variety of garments than did older children, they had a greater number of garments. Infants need enough garments in their wardrobes in order that they may be kept clean and dry. Much of their clothing was given or handed down to them. The infant's clothing is handed down because it is outgrown before it is worn out. Then, too,

Table 11. Typical wardrobes of infants, showing the number and costs of garments on hand and of year's replacements.

Garment*	Garments on hand		Cost of Garment		Replacement during year		All
	Home-made	Ready-made	Home-made	Ready-made	Home-made	Ready-made	
	number		dollars		number		dollars
Cap	0	1	0	.50	0	1	.50
Sweater	0	1	0	1.18	0	1	1.18
Dresses, or suits, cotton	6	0	.23	0	6	0	1.38
Undershirts, cotton knit	0	3	0	.25	0	3	.75
Nightgowns, cotton flannel	2	0	.20	0	2	0	.40
Diapers	0	36	0	1.31	0	30	3.28
Socks	0	3	0	.15	0	3	.45
Shoes, high laced	0	1	0	1.19	0	1	1.19
Total cost for year							9.13

*These infants had in addition 1 cap, 1 wrap—sweater, jacket or coat, 1 pair of overalls or coveralls, 2 dresses or suits, 2 cotton slips, 1 kimono or robe, 1 pair of socks, 1 pair of shoes or booties, made from old materials or hand-downs or gifts, all garments for which there was no cost.

relatives and friends delight in giving the baby a gift. All dresses, slips, nightgowns and robes were made at home.

Infants had two kinds of clothes—dress clothes and home clothes. A brief description of these two types of clothing follows:

For Home

Sweater or sacque.
Heavier cotton dresses or coveralls.
Shoes and socks.*

For Dress

Cap.
Better wrap (as sweater, sacque, or coat).
Better dresses or suits.
Shoes and socks.

*In cold weather only.

Summary and Conclusions

The purpose of this report is to show what clothing members of socially participating farm families have and the frequency with which it is replaced. Since clothing serves a social purpose, clothing of members of socially active farm families should serve as a good guide to other farm families in planning their clothing supplies.

Amount of clothing on hand, and amount bought during the year are listed for each of 11 groups in such families: men (or farm operators), grown boys, high school boys, grammar school

boys, preschools boys, women (or farm homemakers), grown girls, high school girls, grammar school girls, preschool girls, and infants. Costs of garments on hand and cost of yearly replacements are based on the prices of similar garments listed in the most recent catalogue of a popular mail order house.

Garments not purchased for the individual, such as new gifts, second-hand gifts, hand-downs, and garments made from old materials or sacks, are listed separately when found in the typical clothing supply.

Wardrobes of members of socially active families seem to serve as a good basis for checking the clothing choices of one's own family. The question might be asked, "Should choices of social participants be the only basis for planning clothes?" And the answer is, "No." Whether clothing is comfortable, whether it provides protection from cold and rain, and whether it is sufficient in quantity for cleanliness are important points and must be checked too. But the thesis of this report is that clothing serves a social purpose just as food serves a nutritive purpose and, therefore, a guide to planning clothes needs to be made with due emphasis on the social basis.



Tests of

Corn Hybrids and Varieties

at Seven Locations in Mississippi

1942

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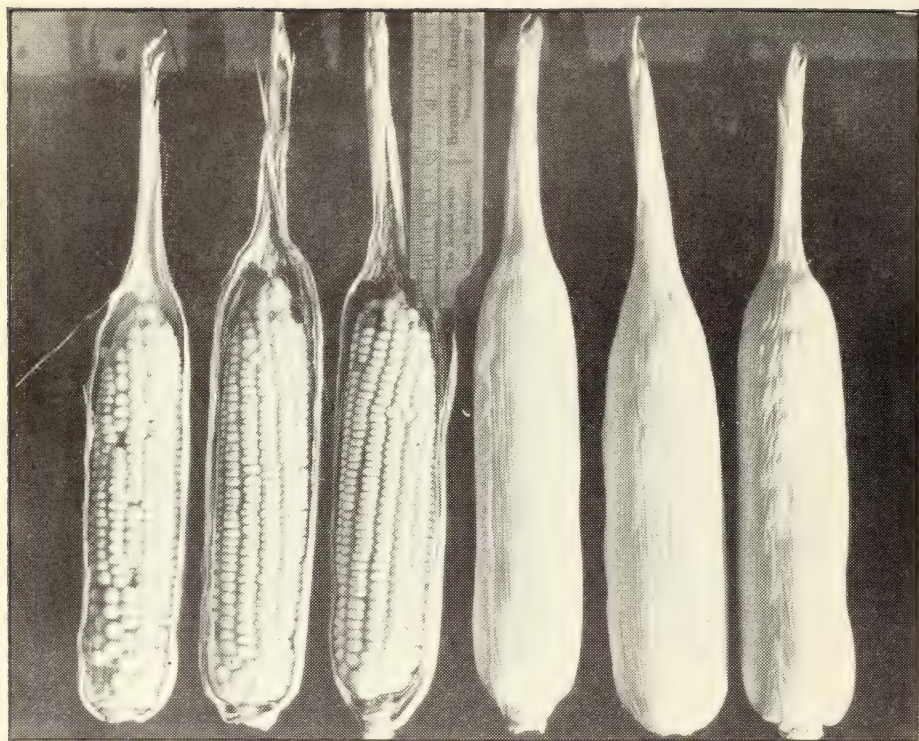
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Type of husk protection needed to protect corn against field infestation by weevils. Generally speaking, ears with husks which barely cover the tips are more severely damaged by weevils and corn ear worm. Better husk covering is one of the objectives sought in the development of Southern corn hybrids.

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Hybrid Corn Tests,* 1942

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Hybrid corn testing was expanded in 1942 to include the performance of 5 varieties and 17 hybrids at 7 locations throughout the State, in comparison with the 3 check varieties: Mosby, College 47, and Neal Paymaster. Of these varieties and hybrids 10 were yellow and 15 were white.

The new hybrids and varieties were introduced as part of the search for strains of corn which might be adapted to Mississippi conditions, as a phase of the expanded program of corn research work being done by the Mississippi Experiment Station in cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture.

Of special interest were yellow varieties, and varieties with good husk protection which would be of special value where heavy field infestations of rice weevil are common. The varieties new in the tests were Hastings' Yellow Prolific, Florident White, Florident Yellow, Yellow Paymaster, and Synthetic No. 2. Synthetic No. 2 is a mixture of six Mosby top-crosses which can be handled as an ordinary open-pollinated variety, thus eliminating the necessity of remaking the cross each year as must be done in the case of corn hybrids.

New hybrids on test this year were Louisiana hybrids 389, 398A, and 468; Texas hybrids 8, 12, and 14; and Missouri 8. Wood's S-320, Funk's G-703 and G-713 are in the main tests for the first time, having been previously tested in preliminary tests for one year. Varieties

and hybrids included in the 1942 tests, together with the name and address of the grower or seed company contributing the seed of each, are listed in table 1.

The tests this year were set up on the basis of a balanced lattice design so that more accurate comparisons might be made between variety means. In all cases this type of analysis proved to be more efficient than when the tests were analyzed as randomized complete blocks.

There were six replications of each test at each location. The plots were 2 rows wide and varied in length from 12 to 20 hills from one station to another, but were all the same size for any one location. Each test was checkrowed to facilitate handling. All seed were treated with a commonly used mercurial dust fungicide before planting, and plantings were made heavy and later thinned to obtain as nearly uniform stands as possible.

Fertilizer Treatments

Cultural and fertilizer practices at the different locations varied from one station to another, but were uniform for each test. At State College, corn followed corn and the only fertilizer treatment was to sidedress with 200 pounds per acre of nitrate of soda. The West Point station followed the practice of bedding the ground in the fall and planting on the ridge at an early date in the spring. The test followed soybeans and received no fertilizer. The Holly Springs test followed corn on land that has been fertilized with phosphates but not in 1942.

*Mississippi Agricultural Experiment Station and the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Agricultural Research Administration, U. S. Department of Agriculture cooperating.

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Table 1. Varieties and hybrids in the hybrid corn tests and the grower or company contributing the seed.

Hybrid or variety	Color	Seed source
Mosby	White	Miss. Agr. Exp. Sta., State College, Miss.
College 47	White	R. W. Killingsworth, Lorman, Miss.
Neal Paymaster	White	Paul Neal, Lebanon, Tenn.
Hastings' Yellow Prolific	Yellow	H. G. Hastings Co., Atlanta, Ga.
Louisiana 468	White	La. Agr. Exp. Station, Baton Rouge, La.
Florident White	White	Geo. W. Munroe, Quincy, Florida
Florident Yellow	Yellow	Geo. W. Munroe, Quincy, Florida
Yellow Paymaster	Yellow	H. E. Gibson, Lenoir City, Tenn.
Florida W-1	White	Fla. Agr. Exp. Sta., Gainesville, Fla.
Funk's G713	Yellow	Funk Bros. Seed Co., Bloomington, Ill.
Louisiana 123	White	La. Agr. Exp. Sta., Baton Rouge, La.
Louisiana 389	White	La. Agr. Exp. Sta., Baton Rouge, La.
Louisiana 398A	White	La. Agr. Exp. Sta., Baton Rouge, La.
Louisiana 3802	White	La. Agr. Exp. Sta., Baton Rouge, La.
Louisiana 3813	White	La. Agr. Exp. Sta., Baton Rouge, La.
Missouri 8	Yellow	McMullin Estate, Sikeston, Mo.
Tennessee 10	White	Fred M. Hull, Russellville, Tenn.
Tennessee 15	White	Eugene Adkins, Veto, Alabama
Funk's G703	Yellow	Funk Bros. Seed Co., Bloomington, Ill.
Texas 8	Yellow	Tex. Agr. Exp. Sta. No. 6, Denton, Texas
Texas 12	Yellow	Tex. Agr. Exp. Sta. No. 5, Temple, Texas
Texas 14	Yellow	Tex. Agr. Exp. Sta. No. 6, Denton, Texas
Wood's S210	Yellow	T. W. Wood and Son, Richmond, Virginia
Wood's S320	White	T. W. Wood and Son, Richmond, Virginia
Synthetic No. 2	White	Miss. Agr. Exp. Sta., State College, Miss.

The test was later sidedressed with nitrate of soda at 200 pounds per acre.

The Raymond test was on ground that had been in corn in 1941. A heavy growth of bur clover was turned under in the spring of 1942, followed with a broadcast application of 300 pounds per acre of 0-8-8 fertilizer. The corn was later sidedressed with 120 pounds per acre of nitrate of soda. The Natchez test followed a green manure crop of vetch. Corn was grown on the test land in 1941 and also followed vetch. The only fertilizer applied was a sidedressing of 200 pounds per acre of nitrate of soda. The Poplarville test followed a green manure crop of Austrian winter peas on land that had grown corn the previous year. Fertilizer was applied in the row by distributor at planting time, at the rate of 600 pounds per acre of 6-8-4.

Explanation of Notes

In computing yields, field weights were converted to bushels of shelled corn per acre, shelling percentages being previous-

ly determined for each entry at each location. Two replications were shelled at each location with the exception of West Point where only one replication of each entry was shelled to determine the shelling percentages.

Poor stands occurred at West Point, Natchez, and Poplarville, so that yields of entries were adjusted to a uniform average stand. At West Point stands were poor because of a dry period following planting; at Natchez and Poplarville poor stands resulted from too much rain following planting. At the other locations stands were fairly comparable and yields were not adjusted.

The tables present the yields on the basis of total yields in bushels per acre and as a percentage of the average of the yields of the three check varieties. Plot stands are presented as a percentage of perfect stand, prolificacy is presented on the basis of ears per hundred plants. Actual counts were made on two kinds of lodging: Root-lodging, the result of

a poor root system or roots weakened by insects, diseases, or other factors; and stalk-lodging, which is due to a weak or diseased condition of the stalks, allowing the stalk to break under adverse conditions.

Husk grades are an estimate of husk extension. Four grades were used, ranging from "O", indicating ear tips exposed, to a grade of "3", indicating an extension of the husk 3 inches or more beyond the tip of the ear. Five grades were used in estimating weevil damage and earworm damage: the lower the grade the less the amount of damage, the estimates being made on a plot basis. Weevil damage was estimated only at those locations where damage was heavy enough to give reliable comparisons, and earworm damage was estimated only at State College. Estimates were made by different observers at Poplarville and State College.

Because yields of hybrids and varieties cannot be determined with absolute accuracy, a value is determined by statistical analysis which can be used as a measure in comparing the yields of varieties and hybrids. A difference of any two varieties or hybrids must exceed this value before differences can be considered significant and be expected to exist under a similar set of environmental conditions.

For the convenience of the reader, a statement is inserted in the tables giving the number of bushels by which any two varieties or hybrids must differ before that difference can be accepted as real. The statement is placed below the group of entries whose yields do not differ significantly from the yield of the strain which ranked first in the test.

In addition to yields, other factors should be considered before any conclusions are drawn as to whether a variety or hybrid is better in performance than another hybrid or variety.

State College

The season at State College was characterized by the shortage of rainfall during most of the growing period. Sufficient moisture was present at planting to secure good stands. This year, as shown in table 2, seven hybrids yielded significantly better than Mosby. Of these, Tennessee 10 showed the least amount of root-lodging and Louisiana 398A had the least stalk-lodging. Tennessee 10 had the least total lodging and was considerably better than Mosby in root-lodging resistance.

Although Funk's G703 was significantly better yielding than Mosby, it had very little husk protection and had more weevil damage than Mosby at Natchez and Poplarville where weevil damage was heavy enough to be noted. This hybrid had a rather high percentage of broken stalks, which is very undesirable, and died prematurely as a result of disease injury.

Another yellow hybrid which did not yield significantly less than Louisiana 3802 was Texas 8. Its lack of husk coverage, making it susceptible to field infestation by weevil, makes it rather undesirable.

Average yields for the past 4 years, as shown in table 3, indicate that Tennessee 15 has a 10.5 percent increase in yield over the average yield of the check varieties. For the same period Wood's S210, a yellow hybrid, has shown a small increase of 5.2 percent. For the past 3 years, Tennessee 10 and Louisiana 3802 have shown an increase of a little more than 11 percent. Both of these hybrids have comparatively good lodging resistance and should be preferred over Tennessee 15 for that reason.

West Point

The stands at West Point were poor as a result of a dry period following planting. The season was marked by less than an average amount of rainfall. However, yields were better this year

CORN HYBRIDS AND VARIETIES

Table 2. Main hybrid corn test, Agricultural Experiment Station, State College, 1942.**

Rank	Hybrid or variety	Total yield		Percent of perfect stand	Ears per 100 plants	Percent of plants lodged		Husk grade	Ear-worm grade
		Bu. per acre	Percent of checks			Root	Stalk		
1	Louisiana 3802	61.6	120.3	96.0	178	15.4	1.5	1.3	2.0
2	Louisiana 389	61.1	119.3	97.2	191	21.3	2.1	1.5	2.0
3	Louisiana 123	61.0	119.1	96.8	192	25.2	2.2	2.2	2.0
4	Louisiana 468	60.1	117.4	99.0	156	37.8	1.4	1.3	2.0
5	Louisiana 398A	59.9	117.0	95.8	175	37.0	1.1	1.3	2.0
6	Funk's G703	59.9	117.0	96.6	183	11.0	9.9	0.6	2.5
7	Tennessee 10	59.2	115.6	97.0	165	9.4	3.6	1.2	2.8
8	Tennessee 15	57.6	112.5	98.1	165	16.8	5.7	1.0	2.3
9	Texas 8	57.0	111.3	96.2	114	17.7	8.4	0.2	3.0
10	Synthetic No. 2	56.9	111.1	95.8	139	28.6	8.6	0.6	2.5
A difference in yields of less than 5.0 bushels per acre between any two entries is not considered significant.									
11	Louisiana 3813	56.3	110.0	97.7	202	15.1	4.6	1.8	2.0
12	Texas 12	55.2	107.8	94.6	122	10.6	14.3	0.2	2.8
13	Funk's G713	54.8	107.0	95.6	137	7.0	11.1	0.8	2.6
14	Wood's S210	53.8	105.0	96.6	151	10.1	9.2	1.0	2.5
15	Missouri 8	53.2	103.9	97.0	114	6.4	9.2	0.2	3.0
16	*Mosby	52.8	103.1	98.3	128	22.4	3.6	1.0	2.1
17	*College 47	51.3	100.2	95.2	125	10.7	5.2	1.0	2.1
18	Texas 14	50.7	99.0	94.8	105	5.9	13.4	0.0	2.8
19	Hastings' Yellow Pro.	50.0	97.6	97.5	175	13.8	6.4	1.0	1.8
20	*Neal Paymaster	49.4	96.4	98.1	113	9.8	3.6	1.0	2.0
21	Yellow Paymaster	48.7	95.1	96.2	119	16.2	3.4	1.2	2.6
22	Wood's S320	46.8	91.4	95.6	134	14.2	3.7	1.8	2.0
23	Florida W-1	40.2	78.5	85.0	157	11.8	1.0	2.8	1.0
24	Florident White	37.9	74.0	96.6	129	10.1	3.8	2.2	1.2
25	Florident Yellow	36.8	71.8	98.3	152	17.5	2.5	2.5	1.3
Average of checks		51.2	100.0						

*Check varieties.

**Planted April 15; harvested October 16.

Table 3. Three- and four-year averages, corn hybrid test, State College.

Rank	Hybrid or variety	Yield, bushels per acre				Average	Percent of checks
		1939	1940	1941	1942		
1	Tennessee 10	—	71.8	55.5	59.2	62.2	111.5**
2	Louisiana 3802	—	72.0	52.7	61.6	62.1	111.3**
3	Tennessee 15	38.4	73.7	49.4	57.6	54.8	110.5
4	Wood's S210	34.2	68.2	52.7	53.8	52.2	105.2
5	*Mosby	27.7	66.1	56.4	52.8	50.8	102.4
6	*Neal Paymaster	34.2	67.5	46.2	49.4	49.3	99.4
7	*College 47	31.2	60.3	52.2	51.3	48.8	98.4
Average of check varieties		31.0	64.6	51.6	51.2	49.6	100.0

*Check varieties.

**Compared to the three-year average of check varieties.

than in 1941 (tables 4 and 5). Twelve hybrids and varieties yielded approximately the same as the highest yielding entry. None yielded significantly more than check varieties Mosby and Neal Paymaster, and none of the hybrids was ap-

preciably lower than either of those two varieties in percentage of plants root-lodged or broken.

Incomplete data were taken on this test so that not many characteristics of the hybrids could be compared.

This section is the only one where Texas hybrids were among the highest yielding entries. However, other hybrids yielding equally well have better husk protection, which makes them more desirable than the Texas hybrids.

For a 4-year period, Tennessee 15 has a little more than a 13 percent increase in yield over the average yield of the checks. For the past 3 years Tennessee 10 has better than an 8 percent increase in yield. There is little difference in

Table 4. Main hybrid corn test, West Point Experimental Field, 1942.**

Rank	Hybrid or variety	Total yield		Percent of perfect stand	Ears per 100 plants	Percent of plants lodged		Husk grade
		Bu. per acre	Percent of checks			Root	Stalk	
1	Texas 8	56.9	110.4	77.8	Data not taken	10.2	4.4	Data not taken
2	Texas 12	55.3	107.4	75.7		7.3	11.4	
3	Tennessee 10	54.0	104.8	85.1		11.8	2.4	
4	Synthetic No. 2	53.5	103.8	76.4		7.2	6.4	
5	Louisiana 389	53.4	103.6	75.0		8.8	5.1	
6	*Mosby	53.1	103.1	77.8		9.8	8.5	
7	Louisiana 398A	53.0	102.9	75.7		14.6	5.5	
8	Louisiana 3802	52.6	102.1	79.9		13.0	10.4	
9	Louisiana 468	51.6	100.2	77.1		10.4	7.2	
9	Tennessee 15	51.6	100.2	78.5		14.2	5.8	
11	*Neal Paymaster	51.4	99.8	84.4		9.1	7.0	
12	Funk's G703	51.1	99.2	80.2		5.2	13.8	
A difference in yields of less than 5.8 bushels per acre between any two entries is not considered significant.								
13	Texas 14	50.4	97.8	77.4		8.1	8.1	
13	Louisiana 123	50.4	97.8	76.0		18.7	11.4	
15	*College 47	49.9	96.8	84.4		6.6	8.2	
16	Louisiana 3813	49.5	96.1	77.1		13.5	8.6	
17	Hastings' Yellow Pro.	49.2	95.5	82.3		13.1	17.7	
18	Missouri 8	47.8	92.8	76.7		3.6	4.1	
19	Funk's G713	47.5	92.2	80.6		3.4	6.4	
20	Wood's S210	47.4	92.0	77.4		18.4	7.6	
21	Yellow Paymaster	46.1	89.5	81.2		12.4	4.3	
22	Wood's S320	44.8	87.0	74.0		8.9	7.5	
23	Florida W-1	43.8	85.0	56.9		6.1	1.2	
24	Florident White	36.3	70.4	75.3		10.6	4.6	
25	Florident Yellow	33.9	65.8	75.7		6.8	5.5	
Average of checks		51.5	100.0					

*Check varieties.

**Planted April 2; harvested October 10.

Table 5. Three- and four-year averages, corn hybrid test, West Point.

Rank	Hybrid or variety	Yield, bushels per acre				Average	Percent of checks
		1939	1940	1941	1942		
1	Tennessee 15	17.9	50.8	45.5	51.6	41.4	113.1
2	Tennessee 10	—	49.8	47.1	54.0	50.2	108.2**
3	*College 47	12.8	45.9	46.9	49.9	38.9	106.3
4	Louisiana 3802	—	42.7	48.8	52.6	48.0	103.2**
5	Wood's S210	5.5	46.3	47.9	47.4	36.8	100.5
6	*Neal Paymaster	5.4	45.4	41.1	51.4	35.8	97.8
7	*Mosby	3.1	39.5	44.9	53.1	35.2	96.2
	Average of check varieties	7.1	43.6	44.3	51.5	36.6	100.0

*Check varieties.

**Compared to the three-year average of check varieties.

the lodging resistance of these two hybrids at this station, but the difference shown was in favor of Tennessee 10.

Holly Springs

Some hybrids in the test at Holly Springs (table 6) appeared to be definitely superior to open-pollinated varieties. Louisiana 3802 outyielded Mosby, the best open-pollinated variety, by 10.1 bushels; this is twice the amount required for significance. Of the three highest yielding hybrids, Louisiana 3802 and Louisiana 468 would seem to be the best because the percentage of stalk-lodging in Louisiana 398A is considerably higher than in the other two. None of the hybrids was more lodging resistant than any of the check varieties.

Hybrids in the 1942 Holly Springs test showed the greatest increase in yield over the check average of all the tests in the hill section of the State. However, Tennessee hybrids, which might be expected to perform best in this section, were not significantly different in yield from Mosby and Neal Paymaster.

In a comparison of the 3-year averages (table 7) Louisiana 3802 has yielded 18 percent more than the average yield of the checks. For that period Tennessee 10 has yielded only about 13 percent more. For a 4-year average, Tennessee 15 has shown an increase of about 16 percent. When lodging is considered, Louisiana 3802 or Tennessee 10 would

Table 6. Main hybrid corn test, Holly Springs Branch Station, 1942.**

Rank	Hybrid or variety	Total yield		Percent of perfect stand	Ears per 100 plants	Percent of plants lodged		Husk grade***
		Bu. per acre	Percent of checks			Root	Stalk	
1	Louisiana 3802	61.3	128.5	92.7	160		5.6	3.0
2	Louisiana 398A	59.4	124.5	89.6	167		16.6	2.8
3	Louisiana 468	59.0	123.6	84.1	154		7.1	2.5
A difference in yields of less than 4.9 bushels per acre between any two entries is not considered significant.								
4	Louisiana 389	55.8	117.0	91.6	165		7.1	3.0
5	Louisiana 123	55.0	115.3	89.1	161		10.2	2.8
6	Funk's G713	54.2	113.6	92.4	121		6.4	2.0
7	Louisiana 3813	54.1	113.4	93.0	176		9.5	3.0
8	Synthetic No. 2	53.7	112.6	93.8	121		9.2	1.8
9	Texas 8	53.6	112.4	93.4	106		4.2	2.0
10	Tennessee 10	51.2	107.3	92.4	125		5.9	2.0
10	Texas 12	51.2	107.3	89.6	107		7.8	2.0
10	*Mosby	51.2	107.3	95.0	110		3.2	2.3
13	Tennessee 15	50.4	105.6	92.2	119		21.4	2.0
14	*Neal Paymaster	49.8	104.4	87.0	112		4.4	2.0
15	Funk's G703	49.5	103.8	92.7	131		12.6	2.0
16	Hastings' Yellow Pro.	48.3	101.2	89.8	160		13.9	2.8
17	Missouri 8	47.8	100.2	90.6	104		19.0	1.5
17	Texas 14	47.8	100.2	86.7	103		7.2	2.0
19	Wood's S210	47.3	99.2	89.3	128		9.3	2.3
20	Yellow Paymaster	45.2	94.8	87.2	105		6.2	2.0
21	Wood's S320	43.4	91.0	89.0	117		6.7	2.0
22	*College 47	42.2	88.4	94.0	107		2.2	2.0
23	Florident White	40.3	84.4	92.4	129		6.4	2.5
24	Florida W-1	39.6	83.0	68.2	174		3.8	2.8
25	Florident Yellow	35.8	75.0	94.0	128		6.9	3.0
	Average of checks	47.7	100.0					

*Check varieties.

**Planted May 8, harvested November 6-9.

***Average of only four replications.

Table 7. Three- and four-year averages, corn hybrid test, Holly Springs.

Rank	Hybrid or variety	Yield, bushels per acre				Average	Percent of checks
		1939	1940	1941	1942		
1	Louisiana 3802	—	49.0	73.8	61.3	61.4	118.3**
2	Tennessee 15	17.3	62.8	61.4	50.4	48.0	115.7
3	Tennessee 10	—	54.2	70.2	51.2	58.5	112.7**
4	*Neal Paymaster	11.7	49.6	69.2	49.8	45.1	108.7
5	Wood's S210	10.1	51.7	59.2	47.3	42.1	101.4
6	*Mosby	10.5	48.5	58.1	51.2	42.1	101.4
7	*College 47	9.0	40.6	58.2	42.2	37.5	90.4
Average of check varieties		10.4	46.2	61.8	47.7	41.5	100.0

*Check varieties.

**Compared to the three-year average of check varieties.

be a better hybrid than Tennessee 15 at this location.

Raymond

Yields of five hybrids in this test, shown in table 8, were significantly better than Mosby. However, none of these hybrids

was appreciably lower in stalk-lodging or root-lodging and in most cases was higher than Mosby in percentage of root-lodged plants. Funk's G703 was the only yellow hybrid which was significantly better yielding than Mosby. However, it

Table 8. Main hybrid corn test, Raymond Branch Station, 1942.**

Rank	Hybrid or variety	Total yield		Percent of perfect stand	Ears per 100 plants	Percent of plants		Husk grade
		Bu. per acre	Percent of checks			Root lodged	Broken	
1	Funk's G703	64.6	122.8	95.0	173	12.6	36.1	
2	Louisiana 123	64.2	122.1	89.8	205	17.9	22.3	
3	Louisiana 398A	63.2	120.2	94.3	185	12.9	18.7	
4	Louisiana 3802	61.9	117.6	101.6	177	14.6	29.2	
5	Louisiana 468	61.0	116.0	89.1	185	13.1	22.8	
6	Louisiana 3813	58.7	111.6	95.8	207	20.1	24.7	
A difference in yields of less than 6.4 bushels per acre between any two entries is not considered significant.								
7	Tennessee 10	57.3	108.9	95.0	168	7.9	19.1	
8	Tennessee 15	55.8	106.1	93.2	181	15.6	26.2	
9	Synthetic No. 2	54.3	103.2	86.4	173	13.2	28.9	
10	*Mosby	54.2	103.0	89.6	158	14.8	18.3	
10	Louisiana 389	54.2	103.0	93.8	205	13.3	26.3	
12	Funk's G713	53.7	102.1	90.1	158	7.2	28.6	
13	*College 47	53.4	101.5	90.4	141	10.0	19.3	
14	Wood's S210	50.8	96.6	89.3	168	13.1	27.4	
15	Wood's S320	50.5	96.0	86.4	146	17.1	19.5	
16	*Neal Paymaster	50.3	95.6	90.4	139	11.5	27.0	
17	Texas 14	50.0	95.1	91.4	124	8.8	26.7	
18	Florida W-1	49.5	94.1	82.8	182	14.2	15.4	
19	Hastings' Yellow Pro.	49.2	93.5	94.0	193	11.3	27.4	
20	Yellow Paymaster	48.3	91.8	92.2	125	11.2	22.8	
21	Texas 8	47.0	89.4	90.1	127	14.7	23.4	
22	Florident Yellow	45.1	85.7	93.5	146	9.4	22.0	
23	Florident White	44.7	85.0	93.5	137	11.4	17.2	
24	Missouri 8	43.1	81.9	87.5	125	6.8	36.6	
25	Texas 12	42.7	81.2	89.6	134	13.0	30.8	
Average of checks		52.6	100.0					

*Check varieties.

**Planted May 21; harvested November 2.

Data not taken.

had a high percentage of broken stalks which would make it undesirable when compared with other hybrids yielding equally well or when compared with Mosby. Although data on husk extension were not taken here, information on

husk extension gathered at other locations indicates that Funk's G703 has very little husk coverage and is also undesirable for that reason.

Considering all factors, Louisiana 468

Table 9. Three- and four-year averages, corn hybrid test, Raymond Branch Station.

Rank	Hybrid or variety	Yield, bushels per acre				Average	Percent of checks
		1939	1940	1941	1942		
1	Tennessee 15	42.4	77.6	59.6	55.8	58.8	110.5
2	Tennessee 10	—	71.3	58.1	57.3	62.2	106.7**
3	*College 47	39.6	74.2	50.1	53.4	54.3	102.1
4	*Mosby	35.9	69.8	51.3	54.2	52.8	99.2
5	*Neal Paymaster	37.6	69.9	51.9	50.3	52.4	98.5
6	Louisiana 3802	—	60.3	47.0	61.9	56.4	96.7**
7	Wood's S210	40.6	60.7	50.7	50.8	50.7	95.3
Average of check varieties		37.7	71.3	51.1	52.6	53.2	100.0

*Check varieties.

**Compared to the three-year average of check varieties.

Table 10. Main hybrid corn test, Natchez Branch Station, 1942.**

Rank	Hybrid or variety	Total yield		Percent of perfect stand	Ears per 100 plants	Percent of plants lodged		Husk grade	Weevil grade
		Bu. per acre	Percent of checks			Root	Stalk		
1	Louisiana 468	57.0	126.6	74.8	162	1.8	7.6	2.5	0.3
2	Louisiana 3802	55.1	122.4	66.6	180	4.6	10.8	1.8	0.5
A difference in yields of less than 5.1 bushels per acre between any two entries is not considered significant.									
3	Louisiana 398A	47.5	105.6	61.2	182	4.3	10.8	2.5	1.0
4	Tennessee 10	47.4	105.3	66.6	160	1.0	4.9	1.6	1.6
4	*College 47	47.4	105.3	76.3	127	0.8	15.5	2.0	1.2
6	Tennessee 15	45.9	102.0	73.4	168	3.6	26.6	2.0	2.5
7	Synthetic No. 2	45.8	101.8	68.2	142	3.5	27.3	1.5	2.2
8	Louisiana 3813	45.7	101.6	60.5	211	8.6	27.2	3.0	0.8
9	Hastings' Yellow Pro.	45.6	101.3	65.6	197	4.6	24.0	2.3	1.0
10	Louisiana 389	45.4	100.9	55.4	182	4.0	11.8	2.5	0.3
11	Louisiana 123	45.2	100.4	50.4	198	5.6	17.8	2.0	0.6
12	*Neal Paymaster	44.9	99.8	60.7	134	6.4	26.0	1.6	2.0
13	Texas 12	44.7	99.3	62.9	135	6.2	25.8	0.5	3.3
14	*Mosby	42.8	95.1	79.2	137	3.3	16.6	1.8	1.3
15	Yellow Paymaster	41.4	92.0	72.4	126	3.6	13.9	1.6	2.2
16	Texas 8	41.2	91.6	68.2	116	4.2	9.3	0.8	2.6
17	Funk's G713	40.7	90.4	55.9	158	2.4	40.4	2.0	2.0
17	Wood's S210	40.7	90.4	56.8	154	4.2	36.6	1.8	1.6
19	Funk's G703	40.2	89.3	64.4	174	5.8	31.0	1.5	2.6
20	Florida W-1	39.5	87.8	37.2	183	1.2	8.2	3.0	0.2
21	Wood's S320	37.6	83.6	58.6	140	2.2	14.6	2.3	0.5
22	Texas 14	36.6	81.3	50.8	119	2.2	18.5	0.5	3.5
23	Florident White	36.1	80.2	70.6	142	0.3	15.2	3.0	0.3
24	Florident Yellow	34.5	76.6	65.6	145	2.6	13.0	2.6	0.8
25	Missouri 8	32.0	71.1	38.2	117	4.0	29.3	0.6	4.0
Av. of check varieties		45.0	100.0						

*Check varieties.

**Planted April 7; harvested October 1.

and Louisiana 398A are probably the two best hybrids in this test.

Missouri 8 had the least amount of root-lodging but had the greatest amount of stalk-lodging.

Over a 4-year period, three varieties and two hybrids have been tested at Raymond, as shown in table 9. During this period Tennessee 15 has given an increased yield over the check average of 10.5 percent. Wood's S210 has yielded almost 5 percent less than the check average for the same period. Tennessee 10 and Louisiana 3802 have been on test for the last 3 years. For that period Tennessee 10 has yielded 6.7 percent more than the check average, while Louisiana 3802 has yielded 3.3 percent less.

Natchez

Valuable information was obtained on the performance of hybrids at Natchez, as shown in table 10. Although stands were rather poor, yields were corrected so that those presented would be fairly comparable. Noticeable differences occurred in the amount of stalk breaking, husk extension, and weevil damage. Louisiana 468 and Louisiana 3802 were significantly better yielding than other varieties and hybrids in the test. Louisiana 468 appeared to have more lodging resistance than Louisiana 3802, and also had a longer husk with a correspondingly lower amount of weevil damage. It was also a little less prolific

and would, therefore, have a slightly more desirable ear size. Tennessee 10 had the least amount of stalk-lodging and was also lowest in amount of total lodging. Funk's G713 had the most stalk-lodging.

In the 3- and 4-year summaries (table 11) Tennessee 15 has an increase in yield of 7.3 percent over the average of the checks. This increase is rather small, and when such factors as lodging resistance are considered, it will be found that this hybrid is less desirable than the open-pollinated varieties. Tennessee 10, on the other hand, has a similar increase in yield and has more lodging than the open-pollinated varieties.

Poplarville

Stands were poor at Poplarville but by adjusting yields rather reliable comparisons were obtained. Results are shown in tables 12 and 13.

Of special interest in this test was the performance of the Florida varieties and the hybrid, Florida W-1. This was the most southerly location of the tests, and conditions at Poplarville might be expected to be more similar to those of Florida conditions than at any of the other locations. From the performance of the Florida strains it appears that was the case. Florida W-1, which yielded approximately equal to Mosby at Poplarville, was definitely inferior to the best hybrids at other locations. Florida W-1

Table 11. Three- and four-year averages, corn hybrid tests, Natchez Branch Station.

Rank	Hybrid or variety	Yield, bushels per acre				Average	Percent of checks
		1939	1940	1941	1942		
1	Tennessee 15	61.9	45.9	69.2	45.9	55.7	107.3
2	Tennessee 10	—	43.9	67.7	47.4	53.0	106.2**
3	Louisiana 3802	—	35.1	65.3	55.1	51.8	103.8**
4	*College 47	62.1	40.4	64.2	47.4	53.5	103.1
5	*Mosby	58.8	42.7	67.3	42.8	52.9	101.9
6	Wood's S210	59.9	41.6	55.0	40.7	49.3	95.0
7	*Neal Paymaster	52.1	35.4	64.4	44.9	49.2	94.8
	Average of check varieties	57.7	39.5	65.3	45.0	51.9	—

*Check varieties.

**Compared to the three-year average of check varieties.

Table 12. Main hybrid corn test, South Mississippi Branch Station, Poplarville, 1942.**

Rank	Hybrid or variety	Total yield		Percent of perfect stand	Ears per 100 plants	Percent of plants lodged		Husk grade	Weevil grade
		Bu. per acre	Percent of checks			Root	Stalk		
1	Louisiana 3802	37.5	118.3	85.6	214	2.0	3.9	0.7	1.2
2	*Mosby	36.1	113.8	88.3	181	1.2	2.5	1.2	1.5
3	Louisiana 468	34.4	108.5	87.8	192	6.3	3.8	0.9	1.3
4	Florida W-1	34.2	107.8	45.0	212	2.4	1.2	3.0	0.1
5	Hastings' Yellow Pro.	34.1	107.6	77.2	252	3.6	0.7	1.0	2.0
A difference in yields of less than 3.6 bushels per acre between any two entries is not considered significant.									
6	Florident White	33.8	106.6	70.0	210	5.6	0.0	2.0	0.5
7	Louisiana 123	33.5	105.6	78.3	226	11.4	2.8	1.0	1.3
8	Wood's S320	33.2	104.7	75.6	186	6.6	0.0	1.3	1.2
9	Tennessee 15	32.6	102.8	88.9	187	1.8	2.5	0.2	2.7
9	Louisiana 389	32.6	102.8	83.9	220	4.0	1.3	1.3	1.0
11	Louisiana 398A	32.2	101.6	72.2	211	10.8	1.5	1.2	1.0
12	Louisiana 3813	31.7	100.0	66.7	274	10.8	5.0	1.5	0.8
13	*College 47	30.3	95.6	79.4	178	2.8	4.2	0.8	1.8
14	Florident Yellow	30.1	95.0	79.4	197	5.6	0.7	2.3	0.7
15	*Neal Paymaster	28.7	90.5	79.4	153	2.8	2.1	0.5	2.3
15	Tennessee 10	28.7	90.5	82.2	182	1.4	2.0	0.5	2.7
15	Synthetic No. 2	28.7	90.5	83.3	171	6.0	0.6	0.5	2.0
15	Funk's G703	28.7	90.5	86.7	196	1.3	3.2	0.8	2.5
19	Wood's S210	27.6	87.0	73.9	175	2.2	4.5	0.4	2.5
19	Funk's G713	27.6	87.0	77.8	169	0.0	3.6	0.5	1.8
21	Texas 12	27.2	85.8	85.0	158	2.0	1.3	0.0	3.2
22	Yellow Paymaster	25.1	79.2	69.4	152	2.4	1.6	0.7	2.0
23	Texas 8	23.1	72.8	87.8	131	2.5	1.2	0.0	2.5
24	Texas 14	22.3	70.3	80.6	141	2.8	1.4	0.0	3.6
25	Missouri 8	19.3	60.8	66.7	108	0.0	0.8	0.0	3.5
Average of checks.....		31.7	100.0						

*Check varieties.

**Planted May 21; harvested November 2.

Table 13. Three- and four-year averages, corn hybrid tests, Poplarville.

Rank	Hybrid or variety	Yield, bushels per acre				Average	Percent of checks
		1939	1940	1941	1942		
1	Louisiana 3802	—	32.8	39.1	37.5	36.5	113.4**
2	*Mosby	24.5	32.0	38.7	36.1	32.8	107.9
3	Tennessee 15	32.1	29.0	35.5	32.6	32.3	106.2
4	*College 47	26.1	27.3	35.6	30.3	29.8	98.0
5	Tennessee 10	—	29.5	33.1	28.7	30.4	94.4**
6	*Neal Paymaster	23.9	29.3	31.8	28.7	28.4	93.4
7	Wood's S210	24.5	28.5	32.2	27.6	28.2	92.8
Average of check varieties.....		24.8	29.5	35.4	31.7	30.4	100.0

*Check varieties.

**Compared to the three-year average of check varieties.

hybrid has excellent husk coverage and a correspondingly low amount of weevil damage, and is comparatively good in lodging resistance; however, it shows a poor germination so that stands of this

hybrid are usually thin, which is quite undesirable.

Also of special interest in this test was Hastings' Yellow Prolific, which yielded approximately the same as Louisiana

3802, the highest yielding hybrid. However, Hastings' Yellow Prolific has a poor husk coverage and for that reason is probably less desirable than other varieties which yielded equally well. It is the only yellow variety in the high-yielding group, and where a yellow strain of corn is desired this variety well deserves consideration.

The 3-year averages (table 13) show that Louisiana 3802 has an increased yield of 13.4 percent over the average yield of the check varieties. Although this hybrid does not have the excellent husk protection exhibited by Florida W-1, it has a better average yield for the past 2 years in which they have been directly compared. Also, it does not show the susceptibility to seedling diseases that

Florida W-1 does, giving it a better field stand.

Stoneville

Table 14 gives data for 25 hybrids and open-pollinated varieties tested in 1942. The yield in bushels per acre corrected to 15.5 percent moisture, the percent of perfect stand, percent stalk break, bushel test weight, percent weevil bored sound, percent weevil bored damage, percent total weevil bored, percent total damage, and grade, are given.

The column in table 14 under the heading "percent stalk break" gives the percentage of stalks that was broken below the lowest ear on individual plants when harvested. When stalks are broken low enough to allow the ear to lie on the ground, damage by rot may result.

Table 14. Hybrid corn test, Stoneville, 1942.^{1/}

Rank	Variety	Yield ^{2/} (bushels per acre)	Percent of stalk break	Bushel test weight	Percent weevil bored sound	Percent weevil bored damage	Percent damage by rot	Percent total weevil bored	Percent total damage	Grade ^{3/}
1	Louisiana 3802	117.2	17	58	1.5	9.4	—	10.9	9.4	4 White
2	*Mosby	111.5	11	58	1.5	7.3	.5	8.8	7.8	4 White
3	Louisiana 468	111.5	12	59	2.6	—	1.7	2.6	1.7	1 White
4	Louisiana 389	111.2	12	58	2.0	4.6	.5	6.6	5.1	3 White
5	Louisiana 398A	103.0	13	56	.9	16.9	.5	17.8	17.4	Sample
6	*College 47	98.6	15	58	.5	7.9	.3	8.4	8.2	4 White
7	Louisiana 3813	98.4	19	58	—	7.7	1.0	7.7	8.7	4 White
8	Texas 12	97.5	22	57	2.6	7.6	—	10.2	7.6	4 Yellow
9	Louisiana 123	95.6	15	58	.2	5.2	2.4	5.4	7.6	4 White
10	Wood's S210	95.2	21	58	2.8	14.2	2.3	17.0	16.5	Sample
11	*Hastings' Yellow Prolific	93.0	18	61	—	4.0	—	4.0	4.0	2 Yellow
12	*Neal Paymaster	92.8	12	55	3.6	12.3	1.9	15.9	14.2	5 White
13	Tennessee 10	92.4	6	57	5.5	12.3	1.0	17.8	13.3	5 White
14	Tennessee 15	92.3	10	57	2.5	20.7	.8	23.2	21.5	Sample
15	Synthetic No. 2	89.0	14	57	.6	17.7	.4	18.3	18.1	Sample
16	Funk's G703	87.7	14	56	7.9	9.1	.6	17.0	9.7	4 Yellow
17	Texas 8	86.1	9	55	3.2	18.6	.4	21.8	19.0	Sample
18	Funk's G713	85.9	16	59	1.5	9.9	1.6	11.4	11.5	5 Yellow
19	Wood's S320	83.0	21	57	.4	7.6	3.3	8.4	10.9	5 White
20	*Florident White	81.8	16	60	3.6	2.3	.3	5.9	2.6	1 White
21	*Yellow Paymaster	80.1	8	55	—	12.2	1.6	12.2	13.8	5 Yellow
22	Texas 14	77.3	18	53	1.7	30.0	2.8	31.7	32.8	Sample
23	Missouri 8	72.4	5	54	4.1	27.9	1.9	32.0	29.8	Sample
24	*Florident Yellow	69.6	21	57	—	.4	.3	.4	.7	1 Yellow
25	Florida W-1	66.5	9	61	—	1.2	1.2	1.2	2.4	1 White

^{1/}Planted April 2, 1942. Harvested November 10, 1942.

^{2/}A difference in yield of 12.0 bushels between varieties is necessary for significance.

^{3/}Grades were determined in accordance with official United States grain standard (See table 2).

*Open-pollinated varieties.

A very heavy infestation of stored grain insects was present and was an important factor in determining the grades of different varieties. The columns in table 14 under the headings "percent weevil bored damage" and "percent weevil bored sound" were added together to give "percent total weevil bored."

The columns in table 14 under the headings "percent weevil bored damage" and "percent damage by rot" were added together to give "percent total damage." Percent rot damage is the percentage of

kernels that have been injured by disease and rot. The percent total damage was the grading factor that determined the grade of all varieties in the test.

During the years 1938, 1939, 1940, 1941, and 1942 no hybrid has significantly outyielded College White Mosby, an open-pollinated variety. Mosby has also produced corn of high quality, and has consistently outyielded all Corn Belt hybrids. Louisiana 3802, 3813, and 123 made good yields of quality grain in 1941 and 1942.

Table 15. Grading factors used to determine grades of corn.

Grade no.	Minimum test weight per bushel	Minimum limits of			
		Moisture	Cracked corn and foreign material	Damaged kernels	
				Total	Heat damage
	Pounds	Percent	Percent	Percent	Percent
1	54	14.0	2	3	.1
2	53	15.5	3	5	.2
3	51	17.5	4	7	.5
4	48	20.0	5	10	1.0
5	44	23.0	7	15	3.0

Sample grade, as used in this report, includes corn of the class yellow or white which does not come within the requirements of any of the grades from Nos. 1 to 5, inclusive.

Summaries

Yields have been summarized for the tests located in the hill section of the State, and for the State as a whole (table 16). A study of this table will reveal some things of value to corn growers throughout Mississippi.

Florida W-1 shows a definite regional adaptation. Its yield was significantly below that of Mosby at State College, West Point, Holly Springs, and Stoneville; while at Natchez, Raymond, and Poplarville, there was not a significant difference in the yield of the two strains. If more disease-free seed could be produced or obtained this hybrid would have a special place in the southern part of the State, where its husk protection would be of value in protecting it from weevil. Future testing of hybrid combinations of the inbreds in this hybrid crossed with other inbreds may produce a hybrid which

will give a good yield, good stand, and good husk.

The search for a yellow variety adapted to Mississippi has been rather gratifying in the performance of Hastings' Yellow Prolific. At no location, except Stoneville, was the yield of this variety significantly less than the yield of Mosby, which should indicate its rather general adaptation. However, this variety does not have husk extension which offers much protection from weevil. The performance of Yellow Paymaster, while not as good as Hastings' Yellow Prolific, compares rather favorably with the white strain of Paymaster but has a lower yield.

In direct comparison with Mosby, Synthetic No. 2 showed a slightly lower yield but never a significant increase. At Poplarville and Stoneville its yield was significantly below that of Mosby. At most locations the synthetic variety show-

Table 16. Yield summaries of the main hybrid corn tests—seven locations, 1942.

Rank	Hybrid or variety	Hill stations						Delta Stoneville	Averages	
		State College	West Point	Holly Springs	Ray- mond	Nat- chez	Poplar- ville		Six hill stations	All loca- tions
1	Louisiana 3802	61.6	52.6	61.3	61.9	55.1	37.5	117.2	55.0	63.9
2	Louisiana 468	60.1	51.6	59.0	61.0	57.0	34.4	111.5	53.8	62.1
3	Louisiana 398A	59.9	53.0	59.4	63.2	47.5	32.2	103.0	52.5	59.7
4	Louisiana 389	61.1	53.4	55.8	54.2	45.4	32.6	111.2	50.4	59.1
5	Louisiana 123	61.0	50.4	55.0	64.2	45.2	33.5	95.6	51.6	57.8
6	*Mosby	52.8	53.1	51.2	54.2	42.8	36.1	111.5	48.4	57.4
7	Louisiana 3813	56.3	49.5	54.1	58.7	45.7	31.5	98.4	49.3	56.3
8	Tennessee 10	59.2	54.0	51.2	57.3	47.4	28.7	92.4	49.6	55.7
9	Tennessee 15	57.6	51.6	50.4	55.8	45.9	32.6	92.3	48.9	55.2
10	Synthetic No. 2	56.9	53.5	53.7	54.3	45.8	28.7	89.0	48.6	54.6
11	Funk's G703	59.9	51.1	49.5	64.6	40.2	28.7	87.7	49.0	54.5
12	Texas 12	55.2	55.3	51.2	42.7	44.7	27.2	97.5	46.1	53.4
13	*College 47	51.3	49.9	42.2	53.4	47.4	30.3	98.6	45.8	53.3
14	Hastings' Yellow Pro.	50.0	49.2	48.3	49.2	45.6	34.1	93.0	46.1	52.8
15	*Neal Paymaster	49.4	51.4	49.8	50.3	44.9	28.7	92.8	45.8	52.5
16	Texas 8	57.0	56.9	53.6	47.0	41.2	23.1	86.1	46.4	52.1
17	Funk's G713	54.8	47.5	54.2	53.7	40.7	27.6	85.9	46.4	52.0
18	Wood's S210	53.8	47.4	47.3	50.8	40.7	27.6	95.2	44.6	51.8
19	Wood's S320	46.8	44.8	43.4	50.5	37.6	33.2	83.0	42.7	48.5
20	Texas 14	50.7	50.4	47.8	50.0	36.6	22.3	77.3	43.0	47.9
21	Yellow Paymaster	48.7	46.1	45.2	48.3	41.4	25.1	80.1	42.4	47.8
22	Missouri 8	53.2	47.8	47.8	43.1	32.0	19.3	72.4	40.5	45.1
23	Florida W-1	40.2	43.8	39.6	49.5	39.5	34.2	66.0	41.1	44.7
24	Florident White	37.9	36.3	40.3	44.7	36.1	33.8	81.8	38.2	44.4
25	Florident Yellow	36.8	33.9	35.8	45.1	34.5	30.1	69.6	36.0	40.8
Av. of check varieties.....		51.2	51.5	47.7	52.6	45.0	31.7	101.0	46.6	54.4
Av. of all entries		53.3	49.4	49.9	53.1	43.2	30.1	91.6	46.5	52.9
Significant differences		5.0	5.8	4.9	6.4	5.1	3.6	12.0	2.1	2.5

*Check varieties.

ed less lodging resistance than the original variety. This alone indicates the necessity for a study of more than yielding ability if progress is to be made in producing hybrids and varieties superior to those that exist at present.

The performance of the Louisiana hybrids for the hill section of the State was very good. Four of the six hybrids on test were significantly better than Mosby; when the Stoneville test was included only two were significantly better. Louisiana 3802 was significantly better than all hybrids and varieties except Louisiana 468. On a percentage basis, Louisiana 3802 had an increase of 17 percent in yield over the check average for all locations and an increase over Mosby, the

best open-pollinated variety, of over 11 percent.

None of the other hybrids in the test was significantly better yielding than Mosby. The yields of Tennessee 10, Tennessee 15, Louisiana 389, Louisiana 3813, Louisiana 398A, and Louisiana 123 were approximately equal to Mosby. All other hybrids and varieties in the tests were significantly below Mosby in yield. This is true only of the averages for the State as a whole.

The performance of hybrids from the Corn Belt, such as Missouri 8, indicates that these hybrids are not suitable for conditions in Mississippi, not only on the basis of yield but, also, as regards husk protection, lodging resistance, and other factors.

Broiler Production with High-Protein Feeds

By H. D. POLK and C. E. BARNETT

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BROILER PRODUCTION WITH HIGH-PROTEIN FEEDS

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The production of broilers has increased rather rapidly in Mississippi during recent years. At several production centers, markets and other facilities have been provided, and relatively large numbers of broilers are being produced. In addition, numerous persons are producing broilers in lots of 50 to 100 for home use. In view of the meat scarcity and of war needs for food, it is believed that broiler production may be further and more rapidly increased.

To an extent greater, perhaps, than any other phase of animal production, proper feeding is important in broiler production. Beef cattle, dairy cattle, hogs, and sheep may be produced at least fairly satisfactorily by the use of simple feed mixtures containing few ingredients and most of them home-grown. For successful broiler production, a variety of feed ingredients is necessary, many of which are not home-grown. Adding further to the difficulty, many of the commonly recommended sources of protein are high in cost and are not carried in stock except by the large feed supply stores.

There are numerous high-protein sources on the market, both animal and vegetable. Those of animal origin include meat scraps, fish meal, shrimp meal (sun-dried and machine-dried), and the various milk by-products, either whole or concentrated by dehydration. High-protein feeds of vegetable origin include cottonseed meal, linseed meal, peanut meal, and soybean meal.

Of the high-protein feeds, only cottonseed meal is readily available to farmers throughout Mississippi. In addition to its widespread availability, cottonseed meal is usually the cheapest protein concentrate available, and its high efficiency as a sole or major source of protein has

been well established in feeding both dairy and beef animals. In the case of poultry, and especially for broiler production, cottonseed meal is usually recommended as one of several sources of protein and to supply only a part of the protein in the poultry ration.

Due, perhaps, to its low cost, its availability, and the general familiarity with its efficient use as a principal source of protein for cattle, the question is often asked: "If I can replace part of the animal protein for chicks with cottonseed meal, why can't I feed all cottonseed meal?"

The Mississippi Station and other experiment stations have fed cottonseed meal to poultry of all ages, and with good results. But it has not been recommended that cottonseed meal be used to replace all of the animal protein or to supply all of the protein supplement in the poultry ration.

In view of the increasing importance of broiler production, it seemed desirable to conduct a series of experiments in which a number of feed mixtures might be tested at various seasons of the year. The poultry department of the Mississippi Station, therefore, set up in 1940 a test to utilize and measure the value of available high-protein feed sources for supplementing commonly-used sources of carbohydrates in chick rations, so that farmers desiring to home-mix poultry feeds might have a rather definite idea of results to be expected.

Since the purpose of this experiment was to determine the efficiency of protein sources available to Mississippi poultrymen for home-mixing chick rations, all the feed materials used were similar in proportions except the high-protein sources. Proteins added to the

basic feed mixtures were obtained from cottonseed meal, soybean meal, meat scraps, and shrimp meals. The formulas are given in table 1.

Rations Used in Test

In all of the seven rations tested, yellow corn meal, wheat shorts, ground whole oats, alfalfa leaf meal, and cod-liver oil were used; and wheat bran, dried skim milk, and salt were used in six of the seven rations. Oystershell flour and steamed bonemeal were used to supply minerals where needed, and while the feed ingredients listed were used in rather uniform quantities, there were some variations due to the difference in constituency of the protein sources, to the end that all of the rations were properly balanced. The principal difference throughout was in the high-protein source.

Ration 1 included machine-dried shrimp meal 10 percent and cottonseed meal 9 percent as the high-protein sources.

Ration 2 included cottonseed meal 22 percent as the sole high-protein source.

Ration 3 included sun-dried shrimp meal 19 percent as the sole high-protein source.

Ration 4 included soybean oil meal 22

percent as the sole high-protein source.

Ration 5 included meat scraps 17 percent as the sole high-protein source.

Ration 6 included machine-dried shrimp meal as the sole high-protein source.

Ration 7 included machine-dried shrimp meal 12 percent, soybean oil meal 5 percent, and cottonseed meal 8 percent, as high-protein sources.

Chemical analyses of the various rations used during the three feeding periods are shown in table 2.

It should be noted from the chemical analyses that the shrimp meals, when used with the other ingredients, carry sufficient minerals and at the proper ratio for normal development of chicks. It should also be noticed that phosphorus and calcium in the meat scraps (ration 5) were considerably higher than in the other rations but approached the desired ratio of two parts calcium to one part phosphorus. It was necessary to add manganese sulphate to the meat scraps ration in the spring and summer of 1942 to prevent perosis or slipped tendons.

At the beginning of the experiment, dried milk was purchased at a cost of approximately 4 cents per pound, but in the spring and summer of 1942 dried

Table 1. Composition of rations used in the experiments.

Feeds	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5	Ration 6	Ration 7
Yellow corn meal	36.5	34.5	38.5	34.5	38.5	38.5	38.0
Wheat bran	10.0	10.0	10.0	10.0	10.0	10.0	—
Wheat shorts	10.0	10.0	10.0	10.0	10.0	10.0	12.0
Ground whole oats	10.0	10.0	10.0	10.0	10.0	10.0	15.0
Dried skim milk	7.5	7.5	7.5	7.5	7.5	7.5	—
Shrimp meal, sun-dried	—	—	19.0	—	—	—	—
Shrimp meal, machine-dried	10.0	—	—	—	—	17.0	12.0
Soybean oil meal	—	—	—	22.0	—	—	5.0
Cottonseed meal	9.0	22.0	—	—	—	—	8.0
Meat scraps	—	—	—	—	17.0	—	—
Alfalfa leaf meal	7.5	7.5	7.5	7.5	7.5	7.5	10.0
Oystershell flour	—	2.5	—	2.5	—	—	—
Steamed bonemeal	—	1.0	—	1.0	—	—	—
Manganese sulphate	—	—	—	—	2.5	—	—
					grams		
Salt	.5	.5	—	.5	.5	.5	.5
Cod-liver oil	.5	.5	.5	.5	.5	.5	.5

Table 2. Chemical analyses of rations used in three poultry-feeding experiments.

Series 1, fed in spring of 1941.

Nutrients	Chemical analysis of rations				
	Ration	Ration	Ration	Ration	Ration
	1	2	3	4	5
	%	%	%	%	%
Moisture	8.20	7.76	8.64	8.50	7.50
Crude fiber	6.07	5.31	4.26	4.19	4.06
Crude fat	4.70	5.23	4.30	4.85	6.20
Ash	7.53	6.60	8.54	6.95	9.15
Protein	21.56	19.94	20.81	20.31	20.19
Nitrogen-free extract	51.94	55.16	53.45	55.20	52.90
Calcium	1.35	1.54	1.55	1.67	2.08
Phosphorus	.81	.88	.77	.71	1.09

Series 2, fed in winter of 1941-1942.

Nutrients	Chemical analysis of rations						
	Ration	Ration	Ration	Ration	Ration	Ration	Ration
	1	2	3	4	5	6	7
	%	%	%	%	%	%	%
Moisture	8.55	8.16	9.33	8.27	8.15	7.71	7.87
Crude fat	5.01	4.87	4.78	4.35	5.77	4.70	4.65
Crude fiber	5.66	5.08	5.23	4.51	3.69	6.06	7.23
Ash	7.16	8.42	8.80	7.46	10.08	8.17	6.71
Protein	21.44	21.81	20.88	22.00	21.50	20.94	19.88
Nitrogen-free extract	52.18	51.66	50.98	53.41	50.81	50.42	53.66
Calcium	1.21	1.73	1.54	1.68	1.97	1.88	1.31
Phosphorus	.78	.93	.77	.79	1.34	.84	.66

Series 3, fed in summer of 1942.

Nutrients	Chemical analysis of rations						
	Ration	Ration	Ration	Ration	Ration	Ration	Ration
	1	2	3	4	5	6	7
	%	%	%	%	%	%	%
Moisture	8.74	8.27	9.81	8.20	8.11	7.93	7.91
Crude fat	5.13	4.98	4.62	4.79	5.94	4.91	4.70
Crude fiber	7.28	6.07	6.78	5.89	5.17	7.41	8.40
Ash	6.36	7.14	8.45	6.97	8.67	7.60	6.49
Protein	18.81	19.63	18.94	19.88	21.19	20.81	20.06
Nitrogen-free extract	53.68	53.91	51.40	54.27	50.92	51.34	52.44
Calcium	1.17	1.55	1.66	1.62	1.91	1.85	1.35
Phosphorus	.80	.90	.89	.77	1.26	.79	.73

milk was more than double the cost during the first series, selling for an average of 10 cents per pound. Therefore, dried milk was not included in ration 7, for the purpose of determining whether a saving could be made in feed cost by eliminating milk without adversely affecting the condition and growth of the chicks.

Shrimp meal is a by-product of the shrimp-packing industry. It consists of shrimp hulls, which are dried by two different processes, and ground. Shrimp hulls dried in the sun are commonly

salted; and the use of salt for the purpose of preservation increases the salt content of sun-dried shrimp hulls to around 9 percent and the content of crude protein is thereby reduced to around 45 percent. In machine-dried shrimp meal the dehydration is done by heat artificially applied, and no salt is used; the salt content of machine-dried shrimp meal is approximately 2 percent, and the average content of crude protein is 50 percent. Because of these differences, both sun-dried and machine-dried shrimp meals were included in the comparisons.

Granite grit was made available to the chicks throughout each series of the test.

Methods of Handling Chicks

The chicks used in this experiment were hybrids, New Hampshire males x White Leghorn females. Both the New Hampshire male parents and the White Leghorn female parents of the chicks were from stock with trap nest records of 200 eggs or better.

Fifty chicks were used in each of the five lots fed during the spring of 1941 and in the seven lots fed during the winter of 1942. The number was reduced to 30 chicks during the summer series, due to hot weather and to prevent crowding.

All chicks were grown in starting batteries to 4 weeks of age. The batteries were heated by natural gas burners stationed in the center of each compartment of the battery, and heat was thus supplied as long as it was necessary for the chicks to receive heat. At 4 weeks of age, the chicks were transferred to finishing batteries located in the same battery room and held there for the duration of the experiment.

The chicks were weighed individually at the beginning of the test and weekly thereafter for a period of 9 weeks. A weekly record was kept of feed consumption, mortality, mineral and nutritional deficiencies, feather picking, and condition of birds. At no period of the experiment were artificial lights used.

Feed materials used in mixing the rations were purchased from local feed stores in most cases; however, it was necessary to place special orders for some of the feed materials. All rations were calculated from average chemical analyses for feed nutrients, minerals, and vitamins. The chemical analyses established by Titus in the authoritative book, "Scientific Feeding of Chickens" (1941), were used to calculate and properly balance the rations. The feed

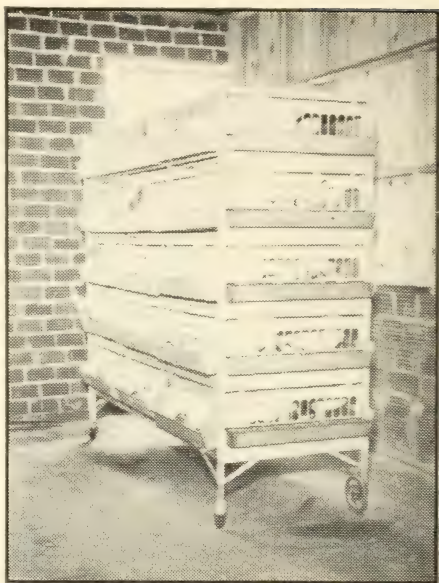


Figure 1. Equipment used in brooding experimental chicks.

materials in each ration were carefully weighed and were mixed in a power-driven feed mixer. Rations used in each series of the experiment were analyzed by the chemical department of the Experiment Station, as shown in table 2. The high-protein source, or sources, of each ration was calculated and supplied in such quantity as to give a ration carrying approximately 21 percent protein.

Altogether, the experiment consisted of three series, conducted during three separate periods. Five lots of 50 chicks each were fed on 5 rations in the spring of 1941; 7 lots of 50 chicks each were fed on 7 rations in the winter of 1942; and 7 lots of 30 chicks each were fed on 7 rations in the summer of 1942.

Results of the feeding experiments are shown in tables as follows: table 3-A, series 1, fed in spring of 1941; table 3-B, series 2, fed in winter of 1941-1942; and table 3-C, series 3, fed in the summer of 1942.

Results of First Series: Chicks Fed Spring of 1941

For the first series, consisting of 5 lots of 50 chicks each, detailed results are shown in table 3-A. Mortality records show one chick lost by death from the soybean oil meal lot, two chicks lost from the meat scraps lot, two chicks lost

from the cottonseed meal lot, three chicks lost from the machine-dried shrimp meal plus cottonseed meal lot, and five chicks lost from the sun-dried shrimp meal lot.

Chicks receiving sun-dried shrimp meal as the sole high-protein source (ration 3) weighed slightly less at the end of the test than those on ration 1, but

Table 3-A. Summary of results of feeding sun-dried shrimp meal, cottonseed meal, soybean oil meal, and meat scraps as high-protein sources in rations for chicks from 1 to 9 weeks of age during January, February, and March, 1941.

Rations	Ration 1 Machine- dried shrimp meal 10 lbs. C. S. meal 9 lbs.	Ration 2 Cotton- seed meal 22 lbs.	Ration 3 Sun-dried shrimp meal 19 lbs.	Ration 4 Soybean oil meal 22 lbs.	Ration 5 Meat scraps 17 lbs.
Number of birds	50.00	50.00	50.00	50.00	50.00
Mortality	3.00	2.00	5.00	1.00	2.00
Feed consumed in lbs.	287.81	308.29	274.25	309.90	287.98
Feed consumed per bird	6.12	6.42	6.09	6.32	6.00
Feed per lb. of gain	2.90	3.06	2.71	2.95	2.72
Feed cost per 100 lbs.	2.18	2.10	2.25	2.14	2.20
Cost per lb. of gain	6.32	6.62	6.10	6.31	5.98
Number of males	24.00	17.00	22.00	22.00	22.00
Av. wt. of males, ozs.	36.43	31.49	35.47	35.04	30.69
Number of females	23.00	31.00	23.00	27.00	26.00
Av. wt. of females, ozs.	30.90	26.31	30.74	29.64	27.94
Av. wt. all chicks, ozs.	33.74	28.14	33.05	32.06	29.02
Slipped tendons	1.00	1.00	0.00	2.00	18.00
Rejects	1.00	2.00	0.00	2.00	10.00

Table 3-B. Summary of results of feeding sun-dried shrimp meal, machine-dried shrimp meal, cottonseed meal, soybean oil meal, and meat scraps as high-protein sources in rations for chicks from 1 to 9 weeks of age during March, April, and May, 1942.

Rations	Ration 1 Machine- dried shrimp meal 10 lbs. C. S. meal 9 lbs.	Ration 2 Cotton- seed meal 22 lbs.	Ration 3 Sun-dried shrimp meal 19 lbs.	Ration 4 Soybean oil meal 22 lbs.	Ration 5 Meat scraps 17 lbs.	Ration 6 Machine- dried shrimp meal 17 lbs.	Ration 7 Mch.-dried shrimp meal 12 lbs. soy- bean meal 5 lbs. cotton- seed meal 8 lbs.
Number of birds	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Mortality	0.00	0.00	1.00	1.00	0.00	1.00	0.00
Feed consumed in lbs.	322.75	294.50	307.50	293.50	286.00	289.00	324.00
Feed consumed per bird	6.46	5.89	6.28	5.88	5.72	5.90	6.48
Feed per lb. of gain	3.10	3.18	3.20	2.96	2.77	2.80	3.30
Feed cost per 100 lbs.	2.84	2.83	2.89	2.83	2.95	2.90	2.34
Cost per lb. of gain	8.83	9.00	9.25	8.36	8.17	8.12	7.72
Number of males	31.00	27.00	25.00	23.00	24.00	21.00	30.00
Av. wt. of males, ozs.	36.14	37.54	34.95	34.99	35.22	36.51	33.80
Number of females	19.00	23.00	24.00	26.00	26.00	28.00	20.00
Av. wt. of females, ozs.	28.71	26.23	27.69	29.90	28.60	31.35	27.88
Av. wt. all chicks, ozs.	33.33	29.64	31.39	31.84	31.77	33.56	31.43
Slipped tendons	0.00	5.00	0.00	2.00	0.00	0.00	0.00
Rejects	0.00	2.00	0.00	2.00	0.00	2.00	2.00

Table 3-C. Summary of results of feeding sun-dried shrimp meal, machine-dried shrimp meal, cottonseed meal, soybean oil meal, and meat scraps as high-protein sources in rations for chicks from 1 to 9 weeks of age during July, August, and September, 1942.

Rations	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5	Ration 6	Ration 7
	Machine-dried shrimp meal 10 lbs. C. S. meal 9 lbs.	Cottonseed meal 22 lbs.	Sun-dried shrimp meal 19 lbs.	Soybean oil meal 22 lbs.	Meat scraps 17 lbs.	Machine-dried shrimp meal 17 lbs.	Mch.-dried shrimp meal 12 lbs. soybean meal oil 5 lbs. cottonseed meal 8 lbs.
Number of birds	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Mortality	1.00	1.00	2.00	1.00	1.00	2.00	2.00
Feed consumed in lbs.	154.25	144.00	146.00	154.25	145.00	176.25	154.25
Feed consumed per bird	5.23	4.88	5.09	5.22	4.94	6.03	5.34
Feed per lb. of gain	2.97	3.20	3.08	3.05	3.01	3.40	2.95
Feed cost per 100 lbs.	2.98	2.91	3.19	2.91	3.26	3.08	2.59
Cost per lb. of gain	8.85	9.31	9.67	8.87	9.80	10.47	7.64
Number of males	11.00	12.00	16.00	12.00	10.00	13.00	13.00
Av. wt. of males, ozs.	31.80	26.58	28.38	31.25	29.78	33.13	31.63
Number of females	18.00	17.00	12.00	17.00	19.00	15.00	15.00
Av. wt. of females, ozs.	26.22	22.38	24.11	24.56	24.42	24.27	27.02
Av. wt. all chicks, ozs.	28.34	24.12	26.55	27.33	26.27	28.38	29.16
Slipped tendons	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rejects	0.00	0.00	0.00	2.00	0.00	0.00	0.00

weighed more than the chicks on other rations in the test. The chicks on ration 3 had the lowest requirement of feed per pound of gain, though the difference between rations 3 and 5 in this respect was not significant. The cost per pound of gain for this lot was slightly higher than that of lot 5 but lower than any of the other three lots.

Ration 1, the check lot in which machine-dried shrimp meal plus cottonseed meal were used as the high-protein sources, produced the largest chicks in this series, but slightly more feed was consumed per pound of gain than in rations 3 and 5; and gains were made at a slightly larger cost per pound of gain than rations 3, 4, and 5.

Chicks on ration 5, receiving meat scraps as a sole high-protein source, averaged in weight only slightly more than the lowest or cottonseed meal group, and were exceeded in weight by the other three groups. Feed consumed per pound of gain was less in three of the four remaining groups. The cost per pound of gain was lowest for the meat scraps

group. However, slipped tendons affected 18 birds, and 10 birds were rejects, in this group of 50 chicks.

Chicks receiving soybean oil meal as the sole high-protein source (ration 4) averaged in weight at the end of the test slightly less than those receiving rations 1 and 3 but somewhat more than those receiving rations 2 and 5. The cost per pound of gain was the second lowest of the five lots. Two birds in this group of 50 were affected by slipped tendons, and 2 were rejects.

Chicks receiving ration 2, in which cottonseed meal was the sole source of high protein, were the lightest of the five groups at the end of the test, consumed more feed per pound of gain than any other group, and made gains at the highest cost per pound of any of the five groups.

In this series, it was observed that three chicks which died in the sun-dried shrimp meal lot had their abdominal cavities filled with a yellowish fluid. Record, Bethke, Wilder, and Kennard reported in 1930 a similar condition from

feeding shrimp meals. These workers also report leg weakness in chicks on this feed.

Notwithstanding the difficulties mentioned, it appears that best results in this series were secured from the sun-dried shrimp meal as the sole high-protein source. It appears also that the poorest results were received from the cottonseed meal lot. However, the combination of machine-dried shrimp meal and cottonseed meal (ration 1) as high-protein sources gave generally favorable results.

Results of Second Series: Chicks Fed Winter of 1941-42

In the first series of the tests recorded above, no comparison was made of machine-dried shrimp meal as a sole high-protein source, and ration 6 was added to provide such a comparison. Also, due to scarcity and high cost of dried milk, this material was omitted from ration 7, and chicks on this ration received protein from a combination of machine-dried shrimp meal, soybean oil meal, and cottonseed meal.

Ration 7 was designed for an all-purpose ration. Therefore, it was simplified as much as possible to reduce cost and numbers of feed materials used.

Machine-dried shrimp meal (ration 6) produced chicks weighing an average of 33.56 ounces, which was high for series 2, although there was little advantage in final weights over ration 1. Detailed results are shown in table 3-B. In feed per pound of gain, chicks on ration 6 were about average, but these chicks were next to the lowest in cost per pound of gain.

Cottonseed meal chicks (ration 2) again were lowest as in series 1, averaging only 29.64 ounces per chick; in addition to lightest weight, the cottonseed meal chicks were next to the highest in cost per pound of gain.

The meat scraps lot (ration 5) soybean oil meal lot (ration 4), and the sun-

dried shrimp meal lot (ration 3) were approximately equal in final weight, being somewhat lighter than chicks receiving rations 1 and 6 and somewhat heavier than chicks receiving ration 2. The sun-dried shrimp meal lot cost 9.25 cents per pound of gain, the soybean oil meal lot 8.36 cents, and the meat scraps lot 8.17 cents.

Chicks receiving ration 1, with proteins derived from sun-dried shrimp meal and cottonseed meal were very slightly exceeded in final weight by those receiving ration 6, and more economical gains were made by chicks on rations 4, 5, 6, and 7.

Chicks on ration 7, in which protein was derived from 12 pounds of machine-dried shrimp meal plus 5 percent soybean oil meal plus 8 percent cottonseed meal, were slightly exceeded in weight by chicks on rations 1, 4, 5, and 6, and consumed more feed per pound of gain than any other lot in the test. However, ration 7 cost considerably less per 100 pounds of feed, and gains were made at the lowest cost of any of the lots.

In this, the spring series, mortality was very low and did not exceed 4 percent with any ration. Slipped tendons accounted for 10 percent of the cottonseed meal chicks. It is interesting to note that by adding 2.5 grams of manganese sulphate, perosis (which accounted for 18 chicks or 36 percent of the chicks in the previous test) was completely eliminated. Two chicks on ration 3 (sun-dried shrimp meal) died, and it was observed that their abdominal cavities were filled with a yellowish fluid; two additional chicks exhibited symptoms of the same condition but overcame this condition in about 14 days.

Results of Third Series: Chicks Fed Summer of 1942

The summer series in this broiler feeding experiment was conducted during the months of July and August and the

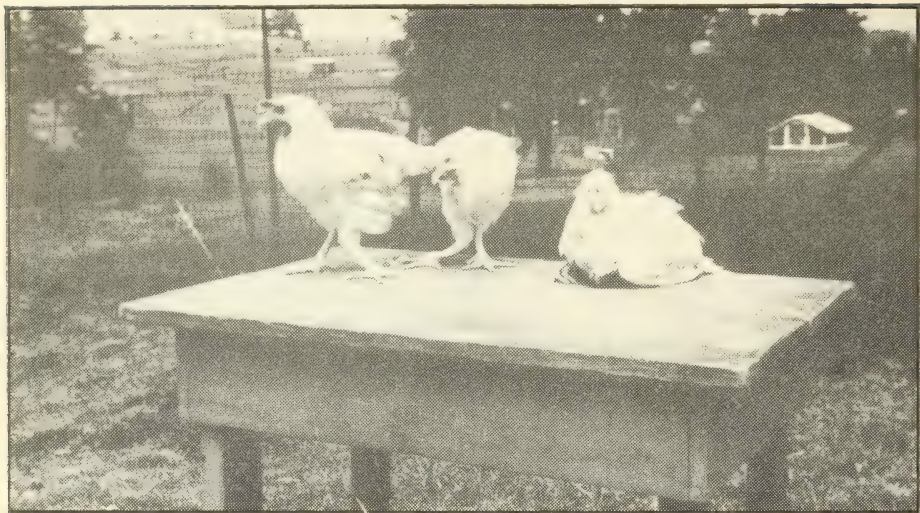


Figure 2. Nutritional disturbances which affected some of the experimental chicks: 2 chicks at left, slipped tendons (perosis); 1 chick at right, curl toe paralysis.

first week in September. During the 9 weeks of this series, the weather was extremely hot and dry, which is normal for this area except for the lack of rainfall. In addition to the difficult weather, all of the chicks in this series of the test contracted bronchitis at 7 weeks of age, which probably lowered the average weight of chicks on each of the rations.

Mortality in this series was considered as low and not above that normally expected with chicks brooded under more favorable climatic conditions. In this series no trouble was encountered in the sun-dried shrimp meal ration on account of abdominal cavities being filled with fluid, no chicks in any of the several lots came down with slipped tendons, and there were no rejects. Detailed results are shown in table 3-C.

Chicks receiving rations 7, 6, 4, and 1 were rather uniform in weight, the difference between the highest and lowest being less than 2 ounces. Chicks in rations 3 and 5 averaged nearly 3 ounces less than those receiving ration 7, and chicks receiving ration 2 averaged in

weight over 5 ounces less than those receiving ration 7.

As in the previous series, chicks receiving cottonseed meal as a sole high-protein source (ration 2) were lowest in average weight. Differing from results in the first series, chicks receiving sun-dried shrimp meal weighed somewhat less than those receiving other rations, and gains in weight cost considerably more per pound of gain. Chicks receiving machine-dried shrimp meal as the high-protein source ranked second in average weight at the end of the test, but more economical gains were made by chicks on three other rations. The meat scraps lot was high for all rations in cost per pound of gain.

Ration 7, in which protein was derived from machine-dried shrimp meal plus soybean oil meal plus cottonseed meal, produced the highest average weight per chick in the summer series, and gains in weight at the lowest cost per pound of gain.

Differences in cost per pound of gain were significant in this, the summer

series except rations 1 and 4. The costs per pound of gain were as follows: ration 4, 8.87 cents; ration 2, 9.31 cents; ration 3, 9.67 cents; ration 5, 9.80 cents; and ration 6, 10.47 cents.

Summarized Results of Tests of Five High-Protein Sources for Chicks

A summary for the three series of this experiment is given in table 4. The percent of mortality for chicks on each ration is considered as low and within the mortality rate normally expected. All deaths of chicks were due to weak chicks except those fed the sun-dried shrimp meal ration.

Sun-dried shrimp meal had another objectionable feature, in that the droppings were watery throughout each series of the experiment. This is probably due to the excessive salt in the shrimp meal, which caused the chicks to drink more water than those on the other rations. The excessive water in the droppings is objectionable from the standpoint of

cleaning the pan, and caused high depreciation on the equipment, especially on the dropping pans.

Machine-dried shrimp meal fed as the sole high-protein source was the most satisfactory of all single high-protein sources from the standpoint of average weight per chick, being only 0.65 ounce below the control ration and 0.67 ounce above the sun-dried shrimp meal ration. Only one case of slipped tendons developed where machine-dried shrimp meal was fed in combination with vegetable proteins, with or without milk. There was no significant difference in average weights per chick for rations 3, 4, and 7.

Cottonseed meal fed at the rate of 22 pounds in 100 pounds of the feed mixture was the least satisfactory of all high-protein feeds from the standpoint of average weight per chick, slipped tendons, vigor, and condition.

Cottonseed meal chicks' feathers were ruffled and the birds lacked vigor and condition when compared with the chicks

Table 4. Summary of tables 3-A, 3-B and 3-C of feeding sun-dried shrimp meal, machine-dried shrimp meal, cottonseed meal, soybean oil meal, and meat scraps as high-protein sources in rations for chicks from 1 to 9 weeks of age, through winter, spring, and summer seasons, 1941 and 1942.

Rations	Ration 1 Machine-dried shrimp meal 10 lbs. C. S. meal 9 lbs.	Ration 2 Cotton-seed meal 22 lbs.	Ration 3 Sun-dried shrimp meal 19 lbs.	Ration 4 Soybean oil meal 22 lbs.	Ration 5 Meat scraps 17 lbs.	Ration 6 Machine-dried shrimp meal 17 lbs.	Ration 7 Mch.-dried shrimp meal 12 lbs. soy-bean meal 5 lbs. cottonseed meal 8 lbs.
Number of birds	130.00	130.00	130.00	130.00	130.00	80.00*	80.00*
Percent mortality	3.88	2.31	6.15	2.31	2.31	3.75	2.50
Feed consumed in lbs.	254.94	248.93	262.50	252.55	239.66	232.63	239.25
Feed consumed per bird	5.88	5.75	5.60	5.83	5.53	5.82	5.98
Feed per lb. of gain	2.99	3.37	3.06	3.07	3.08	3.16	3.13
Feed cost per 100 lbs.	2.67	2.61	2.87	2.63	3.31	2.99	2.47
Cost per lb. of gain	7.98	8.80	8.77	8.07	10.19	9.45	7.73
Number of males	66.00	56.00	63.00	57.00	56.00	34.00	43.00
Av. wt. of males, ozs.	35.53	30.96	33.46	34.22	31.99	35.22	33.15
Number of females	60.00	71.00	59.00	70.00	71.00	43.00	35.00
Av. wt. of females, ozs.	28.40	25.34	28.15	28.13	26.82	27.95	27.51
Av. wt. all chicks, ozs.	32.33	27.81	30.89	30.94	29.54	31.68	30.62
Number slipped tendons	1.00	6.00	0.00	4.00	18.00	0.00	0.00
Number rejects	1.00	4.00	0.00	6.00	10.00	2.00	2.00

*Only two series conducted on rations 6 and 7.

on other rations. Two of the cottonseed meal chicks came down with a form of leg paralysis in series 1 and one chick in series 2. The toes were curled, exhibiting typical symptoms of curl toe paralysis. This condition was probably caused by some factor in cottonseed meal which prevented the chicks from utilizing available vitamins, probably vitamin G. However, cottonseed meal when used to supplement other high-protein sources, as in rations 1 and 7, was fed with good results.

Meat scraps under the conditions of this experiment was supplemented with manganese sulphate to prevent slipped tendons. The poor showing of this ration was due to slipped tendons in series 1. In addition, this meat scraps ration produced chicks which "feather picked" more than chicks receiving the other rations.

Soybean oil meal, when supplemented with minerals in the form of oystershell flour and steamed bonemeal, compares favorably with the other high-protein rations. The chicks on soybean oil meal and cottonseed meal included more that were classed as grading below C grade, and in general did not carry the finish evidenced by the chicks on the other rations.

It should be noted that only two series were conducted on rations 6 and 7, these being added only after the first series of five rations had been completed. The

cost per pound of gain from rations 6 and 7 is apparently higher than some of the other rations, but in reality this is not so. The fact that it appears so is due to low feed prices prevailing at the time the first series was conducted. Feed prices were averaged for all rations for each of the three series, and since rations 6 and 7 were not included in the comparatively low cost schedule of the first series, feed costs, rations 6 and 7 were actually higher than for the other five rations.

Soybean oil meal was more economical to feed as the sole high-protein source than cottonseed meal or sun-dried shrimp meal. Soybean meal was efficiently used to supply a part of the protein as in ration 7.

More economical gains were secured from rations receiving proteins from animal and vegetable sources than from rations receiving proteins from one source only. Ration 7 which includes proteins from machine-dried shrimp meal, soybean oil meal, and cottonseed meal, was the most economical in cost per 100 pounds of feed; and ration 7 produced gains at the least cost per pound. Ration 1, in which proteins were secured from machine-dried shrimp meal and cottonseed meal, produced chicks weighing the most at the end of the three separate feeding periods, and was second only to chicks produced by ration 7 in economy of gains.

SUMMARY AND CONCLUSIONS

1. Shrimp meal, prepared by sun-drying or by machine-drying, carries sufficient minerals when fed as the sole high-protein source or in combination with vegetable protein at the rate of 9 to 12 pounds to practically eliminate perosis (slipped tendons).

2. Meat scraps, fed at the rate of 17 pounds, should be supplemented with manganese sulphate to prevent perosis (slipped tendons).

3. Soybean oil meal, supplemented with minerals and fed at the rate of 22 pounds compared favorably to animal protein sources in average chick weight.

4. Cottonseed meal, fed at the rate of 22 pounds and supplemented with minerals, gave the poorest results of all high-

protein feeds in average chick weight, vigor, and finish.

5. Cottonseed meal, fed at the rate of 8 to 9 pounds gave good results when fed in combination with machine-dried shrimp meal and soybean oil meal.

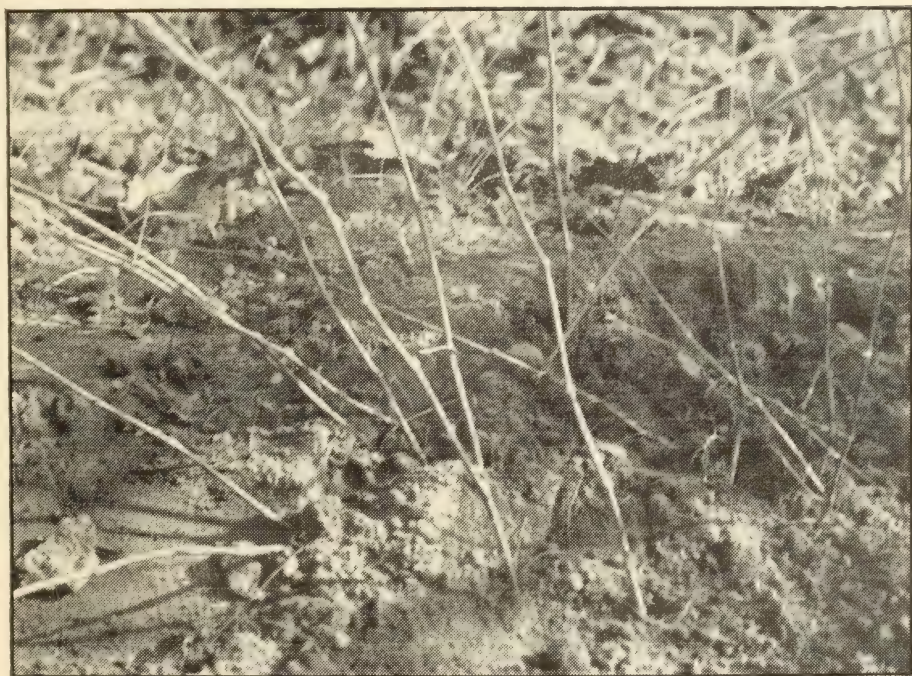
6. Sun-dried shrimp meal is not as efficient as machine-dried shrimp meal when fed as the high-protein source, due to its higher salt content.

7. Ration 7, without milk, produced chicks which averaged 30.62 ounces at a cost of 7.73 cents per pound of gain, and was the most economical ration fed.

8. Machine-dried shrimp meal, as prepared and fed under the condition of this experiment, was utilized just as efficiently by chicks as other high protein sources.



Propagation of Fruits for the Home Orchard



Layering: An entire arm of a muscadine vine has been buried, leaving the young canes extending above the soil. The base of each cane will form roots so as to produce a new plant.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director

STATE COLLEGE

MISSISSIPPI

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Propagation of Fruits for the Home Orchard

By C. H. RAGLAND, Associate Horticulturist

Plants may be propagated in two ways: sexually, by seeds, and asexually, by buds or parts of the plants capable of forming buds. In most annual plants propagation by seeds is a satisfactory method, but with fruits there is so much variability in the seedlings produced from superior varieties that one must resort to some means of asexual propagation in order to be sure of getting fruit of the same quality as the parent variety.

There are several methods of asexual propagation used in propagation of fruits. These include: cuttings, layerings, grafting, and budding. There are several types of each of these, but only a few of the most commonly used of each will be discussed in this paper, since it is not designed primarily for the commercial nurserymen.

Germination of Seeds

Although the use of seeds is not recommended as a means of propagating tree fruits, dependence must be placed upon the seedlings for rootstocks; for most tree fruits are propagated by grafting and budding. To insure good germination, seed to be used for rootstocks usually require special treatment before planting.

Most seeds of annual crops will germinate when planted under favorable moisture and temperature conditions, but seed of many of our fruits require a special treatment known as stratification to insure good germination. The seed of most deciduous trees (those which lose their leaves in winter) have a period after they mature in which they will not germinate regardless of the moisture and temperature conditions to which they are subjected. This is called their "rest period" and will vary with the variety and species. This rest period can be broken by subjecting the seed to a low temperature for a certain length of time, de-

pending upon the variety. For most of the common fruits and nuts, the best temperature will be from 32° to 40° F., and the time will be between 75 and 100 days. The seed should be kept damp while being treated to break the rest period.

A good way to stratify seeds to break their rest period is to place a layer of moist sand in a box, then a layer of seed (the pits of stone fruits are sometimes cracked, but this is not necessary). Repeat this until all seeds are used or the box is full, but be sure there are one or two inches of sand over the last layer of seed to prevent drying out of the seeds. If there is a cold-storage plant located conveniently where a room is held at from 32° to 40° F., the box can be kept in it for about three months. If such a room is not available, place the box in some cool shady place about December 1 and let it remain until planting time. In either case examine the sand at least once a week to be sure it does not dry out, as the seed should never be allowed to dry after they have been stratified. Use a box that is not tight enough to prevent good drainage, for although the seeds **must** be kept damp, they will be ruined if water is allowed to stand over them for any length of time.

It was once thought that the seeds of peaches and plums needed to be frozen in order to break the pits, but it is now known that this is not necessary. Some prefer to plant peach and plum pits, as well as such nuts as pecans, in the fall where the nursery trees are to be grown. This procedure often gives good results but more often is unsatisfactory because of poor growth on account of weed competition.

When planting time comes, which should be about March 1 for most of the

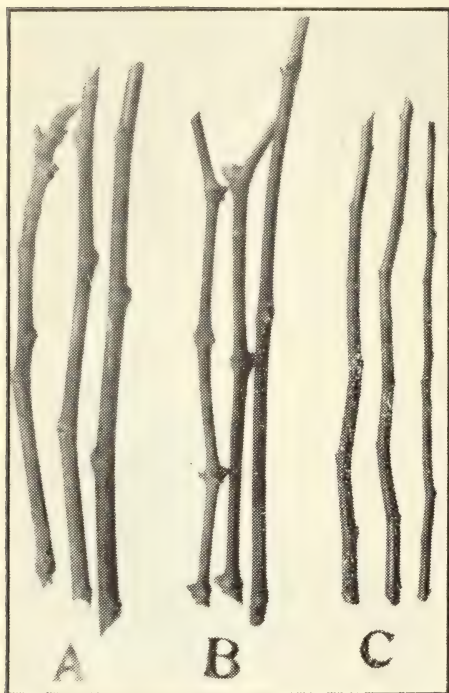


Figure 1. Hardwood cuttings: A, fig; B, grape; and C, quince.

fruits, the seeds are sifted from the sand and planted about one to two inches deep in a well-prepared seedbed. The soil should be fertile or made so by fertilization in order to produce a plant large enough to graft or bud on as quickly as possible. It is best not to fertilize the

nursery with barnyard manure as it is likely to encourage the growth of a bacteria causing a disease on the roots known as crown gall which makes the plant unsafe to plant in the orchard.

Propagation by Cuttings

There are many different types of cuttings, but the one most commonly used in propagating fruits is the simple hardwood cutting. These cuttings are made during the winter months, and of wood that grew the previous growing season. The cutting should be made from good strong wood and at least 6 inches long. The base should be cut just below a node or joint (the point where a leaf was attached), and the cutting should contain three or more buds. The upper cut is usually made an inch or more above a node to prevent drying out of the bud. With grapes, a 3-bud cutting is usually about the right length, but with tree fruits there will usually be more than 3 buds. When the cuttings are planted in the nursery rows, only the top bud is left out of the ground. If the cutting is not at least 6 inches long, the base will not be deep enough to prevent drying out in the event a few days of dry weather occur. Where cuttings are to be rooted in a special propagating bed where they can be watered frequently, they can be made much shorter. Figure 1 shows hardened cuttings of the fig, grape, and quince.



Figure 2. Muscadine vine layer. If vine is covered at only one place it is known as a "simple" layer, and when covered at several places, a "serpentine" layer. Each covered portion will root and can be removed as a rooted cutting.

Some fruits, like the blackberry, may be propagated by root cuttings. Most of the tree fruits which have a tendency to sprout from the roots can also be propagated by root cuttings, but since most of the better varieties are either budded or grafted, their roots will not produce the same variety as the top. Root cuttings are usually made 2 to 6 inches long from the smaller roots, but not less than one-fourth inch in diameter. They may be made in the winter and stored in moist sand until spring, or may be made in late winter or early spring and planted out directly. They may be planted in either horizontal or vertical position. If planted in a horizontal position, they should be covered about an inch deep in a sandy soil. If planted in a vertical position, the end from nearest the mother plant should be uppermost and placed at about the ground level.

Propagation by Layers

Some fruits that are difficult to propagate by cuttings can be readily propagated by means of layering. The difference between a layer and a cutting is that with the layer a portion of the plant is covered and allowed to root before it is cut from the mother plant. This is accomplished in several ways; those most commonly used with fruits in this State are:

(1) **Simple layer**—a branch or vine is bent to the ground and a portion covered

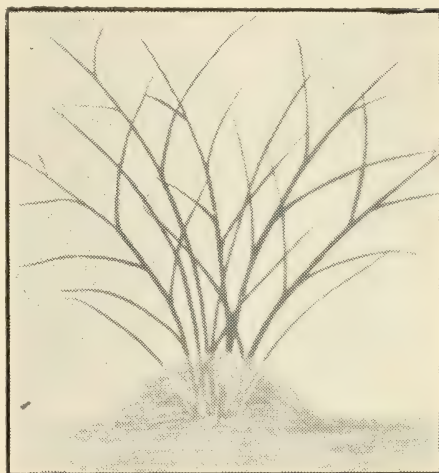


Figure 5. Mound layering. Many fruits growing to a bush form may be propagated this way. After sprouts have rooted at the base they may be removed and treated as a rooted cutting.

with soil, or as in figure 2. If the vine is covered at only one place it is called a "simple" layer, but if covered at several places it is called serpentine layering.

(2) **Tip-layer**—the tip of the shoot is bent to the ground and covered with soil, as shown in figures 3 and 4.

(3) **Mound layer**—the soil is mounded up around the base of a plant which has several stems arising from near the ground level. See figure 5.

Figure 3. Boysenberry cane showing the "tip" layer. Only a small portion of the tip of the growing cane is covered in late September and October. These will root in a few weeks. See figure 4.





Figure 4. Boysenberry tip-layers 6 weeks after layering as shown in figure 3. Note crown, or bud, as indicated by the arrows on two layers to the right (part of the roots have been removed to show crown).

Methods of Propagation by Grafting

There are several types of grafting, but only five types of scion grafts and three types of buds will be described in this paper, as these are types the average fruit grower should use in his propagation work.

Whip Graft

This type of graft is used when the stock (the plant or part of plant on which the desired variety is to be budded or grafted) to be grafted on is an inch or less in diameter.

It is made by making a long sloping cut about three times the diameter of the stock at the top of the stock, as shown in figure 6-A. Now place the knife about two-thirds the distance from base of the cut to the tip and split the stock as shown in figure 6-B. This split should not extend much over one-third the distance of the entire cut or one-half the distance from the start to the base of the sloping cut. Now take a scion (the portion of the plant to be grafted on the stock) about 4 to 6 inches long, and make the same type of cut on the base of it. Fit the prepared stock and scion together, as in figure 6-C, being certain that the cambium (the line of union be-

tween bark and wood) of the stock and scion are in contact on at least one side.

Take a small string or strip of rubber and wrap, as in figure 6-D. Start the wrapping by bringing the string over its end to avoid tying and finish by pulling the upper end in between the scion and stock, as shown in figure 6-D. If string is used, common cotton wrapping twine is best because it will rot in a few weeks and avoid binding when the union begins to enlarge. The scion should never be larger than the stock but may be much smaller, as is shown in figure 6-E.

The graft is now completed and is ready to be waxed if it is above ground or covered with moist soil if it is below the ground. The best time for making this graft is usually during January and February, while both stock and scion are dormant.

Cleft Graft

When one wishes to graft on a stock that is large (one to several inches in diameter), the cleft is one type of graft that can be used. Figure 7 shows the steps in cleft grafting.

First, cut the stock to be grafted, as shown in figure 7-A, leaving a smooth cut. If it is a large limb which may split, it is best to cut it first a few inches above the desired position. Saw from

the lower side of the limb until the saw begins to bind and then finish from above. This will prevent splitting of the stub that remains. If the cut is not smooth, saw it off again a short distance below the original cut.

Now take a grafting tool, figure 8, or some other sharp instrument and split the stock as in figure 7-B. Place the grafting tool or some type of wedge in this split to hold it open enough to take the scion (figure 7-B), but avoid splitting too far as it may not hold the scion tightly and will leave a larger injury than is necessary. Now take a 4- to 6-inch scion and trim it as shown in figure 7-C. Trim both sides the same, with one edge thinner than the other. Place the scion in the stock with the cambiums united and with the thick edge of the scion outside. This is necessary so that it will be in close contact with the cambium of the stock. Remember that the cambium is the line of union between bark and wood and do not be confused by the fact that the bark on the stock is often several times as thick as that on the scion. A good way to insure contact of the cambium in stock and scion is to place the cambium of the scion just outside the cambium of the

stock at the top of the stock and just inside it at the lower end of the scion. In this way the cambium will cross in such a manner as to insure contact for a short distance at least.

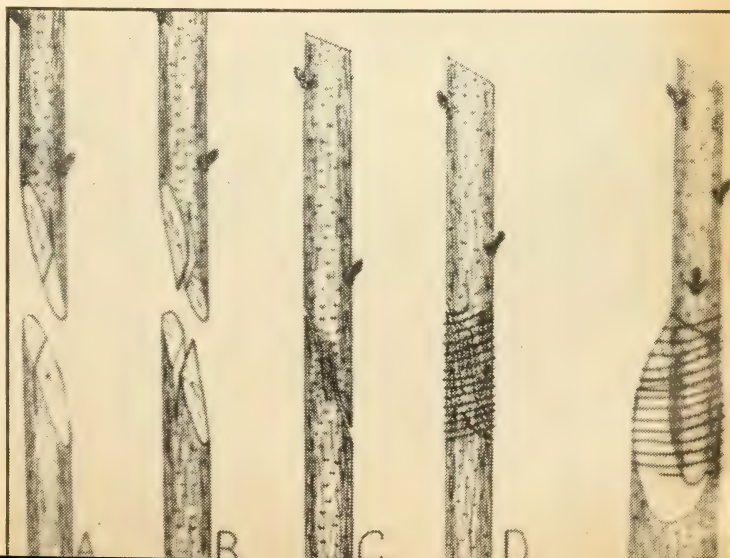
It is not necessary to wrap this type of graft, as the pressure of the stock will hold the scions in place unless the split is made too far down the stock. The cleft graft should be covered with a good grafting wax, figure 7-E. Be sure that the top of the scion is covered with wax to prevent drying out until it has had time to make a union with the stock, and the entire cut surface of the stock, including as far down the sides as it has been split, should also be covered.

Two very important points to remember in making this type of graft are to see that the cambiums of stock and scion are in contact and that all exposed cut surfaces are covered with wax.

Bark Graft

This type graft is used in topworking pecan trees or other trees with a thick, tough bark. It must be done after growth begins in the spring so that the bark will slip, but the scions must be perfectly dormant, which necessitates the cutting of

Figure 6. Whip graft. Used on small stocks one inch in diameter or less. The stock and scion do not have to be the same size, but the scion should not be larger than the stock, and the cambiums must be matched on one side as shown at E.



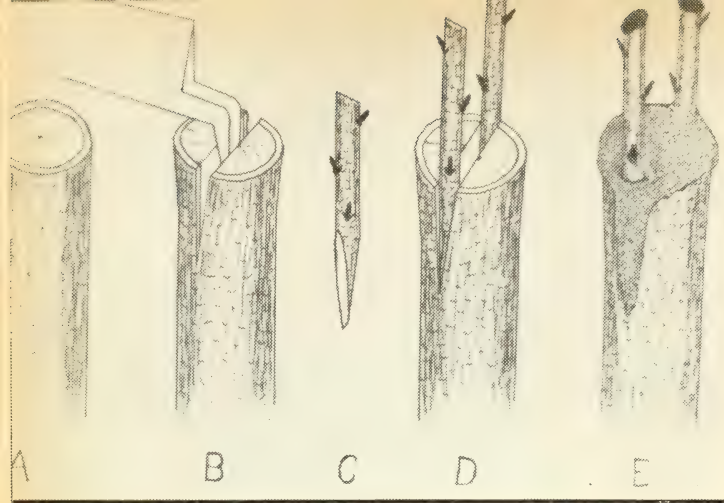


Figure 7. Steps in cleft grafting: A, stock cut; B, stock cut and split ready to receive the scion; C, prepared scion; D, scions inserted and ready for waxing; and E, completed graft. No wrapping is necessary.

scion wood while dormant and storing it until ready for use.

The scion wood should be gathered in February and early March and kept in cold storage until ready to use. It should be wrapped in some moist material such as sphagnum moss and stored at 32° to 40° F. until time to use. If only a small amount is needed, it may be kept in an ordinary electric refrigerator. After placing it in storage, the scion wood should be examined every week or two to be sure it does not dry out. Keep the wood moist at all times, but not wet. It can be kept for a short period at somewhat higher temperatures, but if the temperature is high enough for the buds to begin to swell poor results will be had. The best scion wood is taken from vigorous shoots of the past season's growth. Twigs that have grown 12 inches or more make the best scion wood but less vigorous twigs may be used. If it is not convenient to save one's own scion wood, it can be purchased from most nurserymen who propagate pecan trees.

Figure 9 shows the steps in bark grafting. First, cut the limb to be grafted so as to leave a smooth cut, as in figure 9-A. If the limb is large and likely to split, follow the instructions given under cleft grafting to prevent splitting.

Cut the scion as shown in figure 9-B,

using at least two buds and the total length of the scion should not be over 4 or 5 inches (excessively long scions are more likely to dry out and die before they have time to unite with the stock.) Make the length of the basal cut four to five times the diameter of the scion and make it smooth and straight. The final cut should be made with one stroke of the knife, if possible. A long smooth cut on the scion does much to insure a good fit against the stock which contributes greatly towards the final success of the graft.

Now place the scion with sloping cut against the stock where it is to be in-

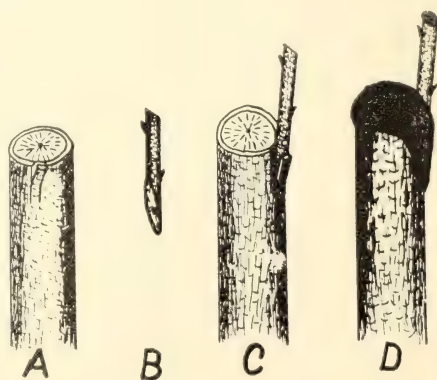


Figure 9. Steps in bark grafting: A, stock cut and small strip of bark raised to retrim the scion; B; C, scion inserted and nailed in place; and D, completed graft after waxing.

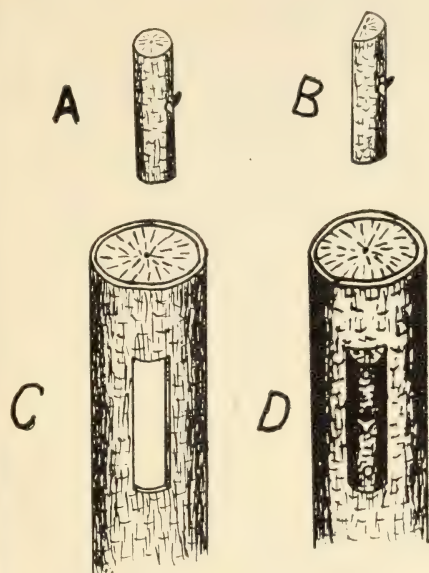


Figure 10. Steps in inlay side graft; A, scion cut with one bud and 3 to 4 inches long; B, the scion with about 1/3 trimmed from the back ready to be inserted on stock ready to receive the scion; C and D show the graft with scion nailed in place and ready for waxing.

serted; then cut and raise a strip of bark the width of the scion as shown in figure 9-A. If the bark is thick and rough, it will be necessary first to trim off the outer rough bark. Insert the scion with the cut surface against the stock and nail in place as shown in figure 9-C. Use a small nail that will not split the scion;

a 1-inch wire brad is about the right size to use. Drive the nail close enough to hold the scion tightly against the stock, but care should be taken not to injure the bark of the scion.

The next step is to cover all cut surfaces with wax as shown in figure 9-D. Be sure that the top of the scion is waxed over, as it will dry out and die if not covered with wax. If a strip of waxed cloth is wrapped tightly around the stock and scion, it will help to hold the scion in place and prevent cracking of the wax.

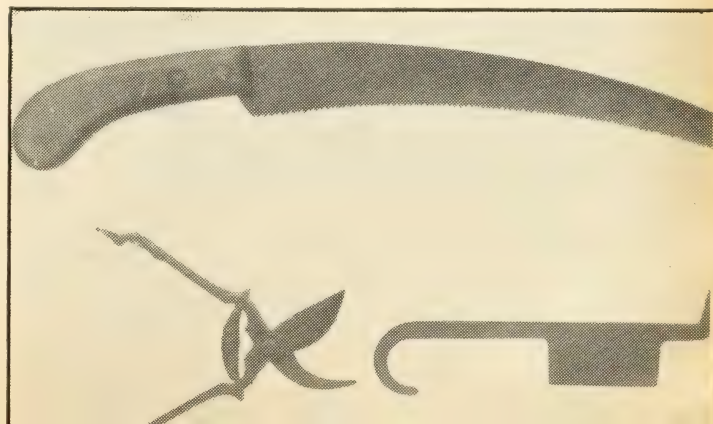
Inlay Side Graft

This is a relatively new method of grafting that has been successfully used in topworking pecans. It is illustrated in figure 10.

To make the inlay side graft, take a scion with one bud on about 3 inches of wood, as in figure 10-A, and cut about one-third of the wood from the scion on the opposite side from the bud. Make this cut straight and smooth. Now trim off the rough bark where the scion is to be inserted, place the cut side of the scion against the stock, and with the knife point, mark the size of the scion. Remove the scion and cut out the strip of bark as shown in figure 10-C.

Place the scion in place, as shown in figure 10-D and nail in place with two small nails. Cover the entire scion with wax to be sure that it is well sealed all

Figure 8. Tools used in grafting: above, pruning saw used to saw off the larger limbs in cleft grafting; lower left, pruning shears which are convenient in cutting scions; lower right, grafting tool used in making split to receive scions in cleft grafting.



around. Wrapping is not necessary and a little wax over the bud, unless too hot when applied, will not prevent it from growing.

With this type of grafting it is not necessary to cut off the limbs until the graft starts growing, but there is less danger of injury to growing scions if large limbs are all removed at the time of grafting. If the limb is not cut at the time of grafting, the bud may be forced into growth by cutting out a narrow band of bark partially around the limb an inch or two above the scion. After the bud has grown a few inches, the limb should be cut off just above it and covered with grafting wax or some material to prevent drying out and rotting.

The scion wood must be gathered while dormant and stored until the bark will slip, as in the bark graft. It is advisable, however, to use the larger scion wood for the inlay graft, as smaller growth splits badly when two nails are driven into such a short piece.

Bridge Graft

Occasionally one has an otherwise healthy tree that has been partially or completely girdled. When the bark is destroyed all around the trunk of a tree, it will often live for from several months to a year but will finally die due to the

roots being starved to death. The roots must have the food manufactured by the leaves, and this food moves down through the bark. By taking scions long enough to reach across the injured area and grafting as shown in figure 11, one can often save a tree that would otherwise die. The only essential difference between this type of graft and the bark graft described above is that both ends of the scion are inserted into the stock, the base below the wound and the top above it. This type of graft can also be used on large wounds on the trunk and large limbs to hasten healing. Whether the tree is completely girdled or only partially so, the scions should be placed about 2 inches apart.

Methods of Propagation by Budding

T-Bud

Of the several types of buds, the T-bud is probably the most widely used. It is usually done in the summer after buds of the current season have matured, and bud wood is cut as needed. The leaves on the bud-stick should be trimmed away as soon as it is cut from the tree. This helps to prevent drying out of the buds, as leaves left on the stick will cause it to dry out much faster. A short

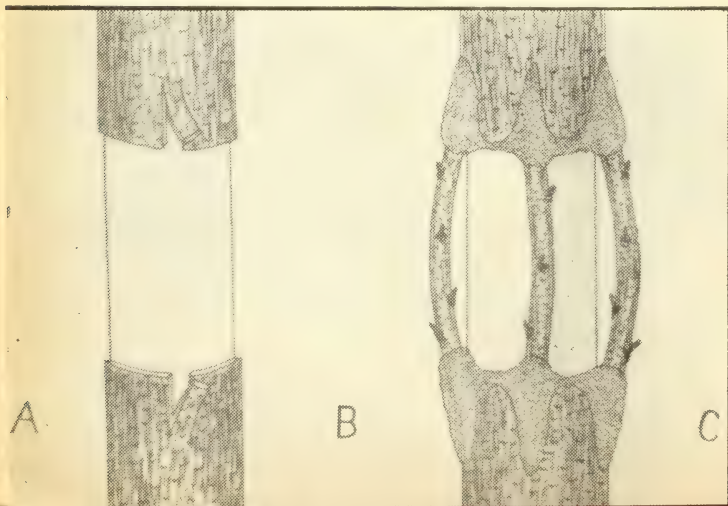


Figure 11. Steps in bridge grafting used in saving girdled trees and hastening the healing of large wounds. The only difference from bark grafting (figure 9) is that the scion is trimmed at both ends and inserted above and below.

Figure 12. Steps in T-budding. A shows how the bud shield is cut from the bud stick. It may be removed with one cut with the knife as B or the top cut may be made at right cut as C. The T is angles to the upward marked off at D above and the bark raised below ready to insert the bud. The bud is inserted as in E, and wrapped at F.



portion of the leaf stem is usually left on to serve as a handle to the bud when it is being inserted. As soon as the leaves are trimmed off, the bud-sticks should be wrapped in moist burlap or other material that will keep them from drying out until used, for once they become dried, they are worthless.

At the point on the stock where the bud is to be inserted, a T-shaped cut is made, the transverse cut being made by a rocking motion of the knife and the vertical one by drawing the point of the knife lightly to about an inch below the first (figure 12-A). Now the bark is raised on both sides of the vertical cut as in figure 12-B, leaving it ready to receive the bud.

The bud is cut from below upward, as in figure 12-C. Start at least a half inch below the bud and extend the cut to the same distance above. It is better to cut the bud longer than the one shown rather than shorter, as the buds live best when cut out on a long shield of bark. Extend the cut well into the wood under the bud, usually about a fourth to a third the diameter of the bud-stick. The top of the shield may be cut with the same upward stroke of the knife used in cutting the bud or by a cut straight to the diameter of the stick. The bud is then removed and inserted in the T-shaped cut and pressed well down.

It is better to arrange the bud so that it fits at the bottom of the shield rather than at the top. Some workers prefer to remove the small strip of wood from under the bud before inserting it, leaving the bud attached to the bark only, but this is unnecessary. Our experience shows that the bud will "take" just as well without removing the wood, and it is much less trouble.

The bud should be wrapped with string, raffia, or rubber as soon as inserted. The wrapping should be tight enough to hold the bud snugly in place, but it is neither necessary nor desirable to try to cover the entire cut area. It is unnecessary to wax this type of bud when it is used on plants to which it is adapted. When either string or raffia is used, the wrapping should be removed in 12 to 14 days in order to prevent binding. If rubber budding strips are used, it will not be necessary to remove them for they will usually deteriorate enough in 2 weeks to break off without any special attention.

Patch Bud

This system of budding is used on plants with a thick tough bark such as pecans, walnuts, and persimmons. Like the T-bud, it is done while the tree is growing. It can be done at any time the bark will slip and well-matured buds are available. In the early spring there

are often buds on the more vigorous shoots of pecans which do not grow but remain dormant. These buds can be used for patch budding, regardless of the age wood they are on. It is best not to try to take a bud from a larger branch than the stock on which it is to be budded, but the reverse will work very nicely. One of these dormant buds can be taken from a small limb and placed on a limb much larger, if the bark on the large limb is pared down thin enough around the bud to allow the wrapping material to hold it tightly against the wood.

Figure 13 shows the steps in patch budding. Figure 13-A shows the bud removed from the bud-stick, 13-B the patch of bark removed from the stock, 13-C the bud taken from 13-A and inserted in 13-B, and 13-D the bud wrapped with waxed cloth. In wrapping be sure that the patch is held snugly against the cambium of the stock and that all cut surfaces are completely covered. If this

is not done, the bud is not likely to take. If waxed cloth or budding tape is not available, one can wrap the bud enough to hold it tightly against the stock with string, raffia, or budding rubber and then cover with melted grafting wax to prevent drying out. From 12 to 14 days will be required for the bud to take well enough to remove the wrapping. To force the bud, cut the stock off a few inches above the bud. When the bud has grown a few inches, cut the stock off just above the bud.

Chip Bud

This is a type of budding that can be done when the bark will not slip. Its principal use to the fruit grower is in putting grapes on vigorous, disease- and insect-resistant stock. Figure 14 gives the steps in chip budding.

A chip with the bud is removed, as in figure 14-A and B. A like chip is taken out of the stock and the bud chip insert-

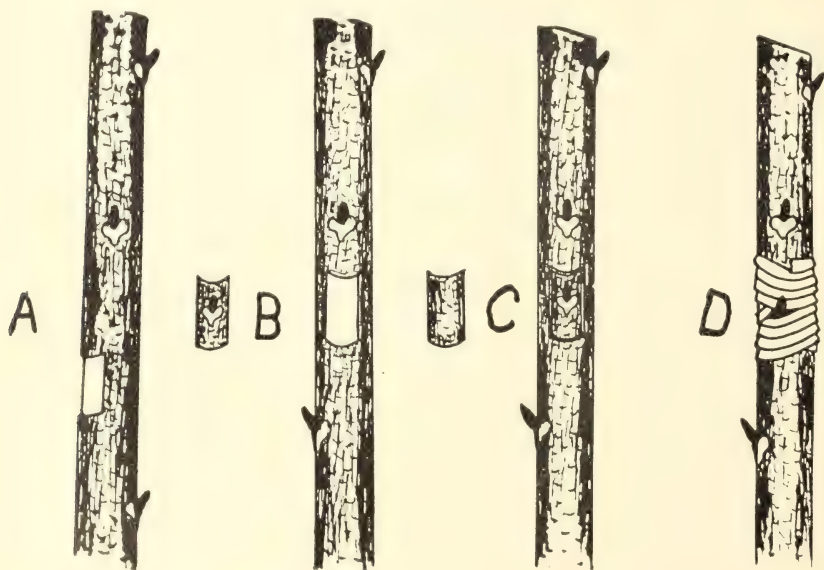


Figure 13. Steps in patch budding: A, the bud removed; B, the patch of bark removed from stock; C, the bud patch inserted; and D, the bud completed. Note that the entire patch is covered. This is done to prevent drying out of the bud before union can take place. Waxed cloth or budding tape is used for this purpose.

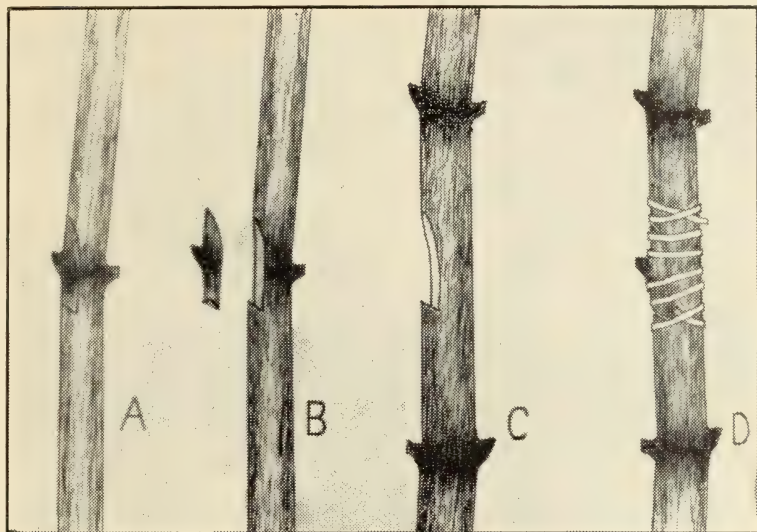


Figure 14. Steps in chip budding used in grapes: A and B show how the bud is removed on a chip of wood. A like chip is removed from the stock as at C. D shows the bud wrapped and ready to be covered with soil.

ed, as in figure 14-C. The chip cut from the stock should be the same size as the bud chip, so that the cambiums will match. Be sure that they meet on at least one side. A chip from a small vine may be made to fit on a much larger stock by the depth of cut made on the stock. After a little practice a good fit may be had on most any size stock. The inserted bud chip is then wrapped as in figure 14-D.

With grapes, chip buds are never waxed but must be covered with moist soil. This makes it desirable to bud a little below the ground level or as near it as possible to make it easy to cover with moist soil. The soil should be allowed to remain until the bud has united with the stock and should not be removed until it is desired to force the bud into growth. Then remove soil and cut the stock off just above the bud. Grapes are usually budded in late summer and left covered with soil until the following spring before being forced.

Propagating Supplies

If only a little propagation is to be done, it will not be advisable to buy special tools, but there are a few that make the work easier. For cleft grafting the grafting chisel, figure 8, and a mallet are needed. The wedge-shaped prong on

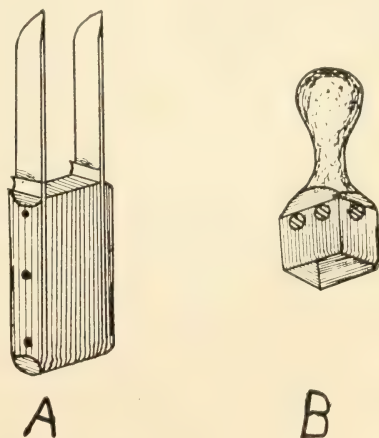


Figure 15. Budding knives used in patch budding.

the back of the grafting chisel is used to hold the split stock open until the scion is inserted, figure 7-B. The curved pruning saw is a good type, and hand shears, figure 8, are convenient for cutting limbs for cleft grafting, and scions for all types of work.

In patch budding the knives shown in figure 15 make the work much easier. The one shown in figure 15-A can be made by binding two ordinary pocket knives on a block of wood so that the blades are an inch apart. It is used to cut the patch the correct length. The width of the patch bud is about one-half inch, and must be estimated. This knife can also be purchased from almost any nursery supply company. Figure 15-B illustrates a knife that cuts all sides of the patch in one operation and insures a perfect fit. It is known as the Jones patch budder and can be purchased from most nursery supply companies.

Grafting wax may be purchased from nursery supply companies or made in accordance with the following formula:

- 4 pounds rosin
- 1 pound beeswax
- 1 pint linseed oil
- 1 ounce lampblack or finely powdered charcoal.

Melt the rosin, add the beeswax, and when completely melted, add the linseed oil. Remove from the fire, and stir in the lampblack. In use, this wax is heated just enough to melt it, and is applied with a brush. Care must be taken to prevent its being used hot enough to injure the plant. There are several other formulae for making grafting wax, but the above is a good wax, and the materials can be purchased from most drug stores.

Waxed cloth for budding and grafting can be made by tearing cloth, such as old sheeting, into strips about $1\frac{1}{2}$ inches wide. Roll this tightly into rolls about $1\frac{1}{2}$ to 2 inches in diameter, drop into boiling wax without lampblack, and

leave until thoroughly saturated. Remove and let drain and cool, after which it can be stored until needed. This material may be used full width in wrapping some grafts, such as topworking pecans, or torn into strips $\frac{1}{4}$ to $\frac{1}{3}$ inch wide for buds. Grafting thread may be waxed by soaking the balls in boiling wax.

T-buds are ordinarily wrapped with raffia or rubber budding strips, although ordinary small cotton twine may be used. When raffia is used it must be kept wet in order to wrap and tie well. The rubber budding strips are preferred as they stretch enough not to bind the growing stock and do not have to be removed to prevent binding after the bud has set. Either the rubber strips or raffia can be purchased from a good nursery supply company.

Methods of Propagating Tree Fruits

Apples—Apples may be either budded or grafted on apple seedlings. The seedlings may be grown from seed or purchased from a nurseryman. They may be root-grafted or they may be planted in the nursery and budded the following summer.

Apple seeds should be stratified for about 3 months before planting. The seeds may be sown in flats or coldframes in the spring and the seedlings transplanted to the field after the second pair of leaves are formed. They may also be planted directly into rows in the nursery. The seeds should be planted about one inch apart and covered about one inch deep. In either case the seedlings should be grown in the nursery 1 to 2 years before being large enough to graft on. The seedling should be $\frac{1}{4}$ inch in diameter or larger at about the level of the ground before it is grafted on by the whip graft method.

Dig the seedlings during the dormant season and store them in a cool damp place until time to graft (January and

February). Scion wood from the desired variety may be cut when ready for use or it may be cut earlier and stored in a damp cool place. Do not allow scion wood to dry out, and the work should be done before the buds begin to swell. Use the whip graft on the main root which may be cut into about 4-inch sections and a scion placed on each one that is large enough. After completing the grafts they may either be set in the nursery or buried in a well-drained soil until ready to set, which should not be later than the first half of March. Set in nursery rows 6 to 8 inches apart with only one bud of the scion above the ground. These grafts should make 3- or 4-foot trees, which are good sizes to set in the orchard, by the following fall.

Apples may be propagated very easily by the T-bud. They are budded in June and July, and if done by the first of July, they can be forced into growth but usually will not make a tree large enough to plant in the orchard the following fall.

If it is desired to topwork a bearing apple tree, the cleft graft should be used in January or February. Wax all apple grafts which are made above the ground.

Pears. Pears may be propagated in the same way as apples, except the whip graft should be waxed even though it is to be covered with soil. Pear stocks are usually used but quince may be used for some varieties when one desires a dwarf tree. Some varieties, such as the Pineapple, propagate readily from hardwood cuttings taken in January and February, but many of the better varieties root with difficulty from seed cuttings. Pear trees may be top-grafted by using the cleft graft. Figure 16 shows a young tree with 2 years growth after being top-grafted.

Peaches. Peaches are propagated by budding on peach roots. Plum rootstock may be used but is not as satisfactory. Peach pits should be stratified $2\frac{1}{2}$ to 3 months before planting. They are plant-

ed in early March about 4 to 6 inches apart and covered $1\frac{1}{2}$ to 2 inches deep. If planted on fertile soil and kept free of grass and weeds, the seedlings should be ready to bud by June. The T-bud is used, and the bud is forced about 14 days after it is set. The seedlings should be budded as close to the ground as convenient, usually 2 to 3 inches. If the budding is done in June and all growth except from the bud is removed as it appears, this should make a tree large enough to set in the orchard by the end of the growing season. Plum stock will give a tree that can withstand slightly

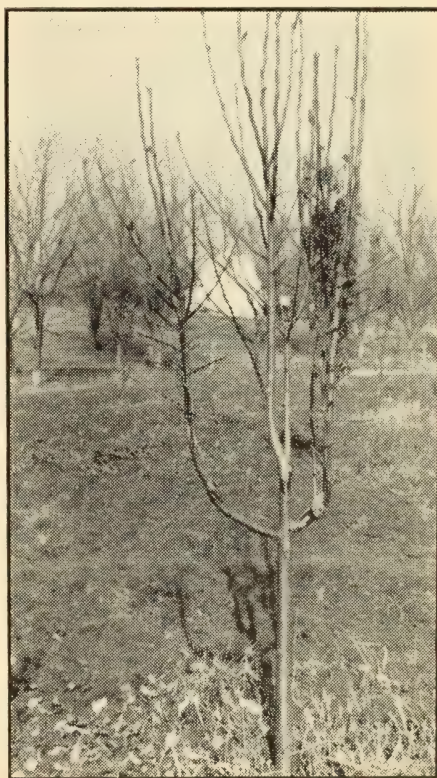


Figure 16. Pear tree top-grafted by the cleft-graft method in February 1941. Picture taken December 1942. Enlargements on the three main limbs near the trunk show where grafts were made.

wetter soil but, as a rule, is not as desirable otherwise. Peach trees can be topworked by the cleft graft, but the tree is usually so short lived in this State that it is better to set another tree than to spend time and money on an old one.

Plums. Plums are propagated the same way as peaches. Peach rootstocks may be used, but plum seedlings are preferable. The seed are treated in the same way as peaches except it is best to stratify them a little longer. Some plums can be rooted from hardwood cuttings taken in January and February while other varieties root with difficulty.

Pecans. Pecans may be propagated by either grafting or budding. For nursery propagation the whip graft and patch bud are most commonly used, and pecan seedlings are used as rootstocks.

The nuts should be stratified for at

least 90 days to insure good germination. Plant the nuts about 6 to 8 inches apart in a well-prepared seedbed and cultivate enough to keep the young seedlings free of grass and weeds. Two years are required for the seedlings to be large enough to whip graft. In January or February, before the third growing season, the soil is removed to a depth of 4 to 6 inches around the roots and the scion grafted on the tap root. This is done without digging the tree, and below the ground level. Wrap the graft with twine to hold the scion firmly and mound with soil leaving only the top bud of the scion exposed. Stocks on which the grafts do not take will usually sprout from the root and can be patch budded the following summer, or the seedlings may all be budded during the third growing season instead of grafting. Hickory seedlings may be used as rootstocks for pecans, but the growth is not usually satisfactory and is not recommended.

Pecan trees may be topworked by the bark graft, inlay side graft, cleft graft, or patch bud. It is possible to topwork most any size tree, but the cost of caring for the extremely large trees is usually too great to justify it. Trees with a main trunk of 12 inches in diameter or less are the more desirable sizes, since it is usually possible to cut the limbs for grafting where they are less than 3 inches in diameter and still be able to place the graft within 3 or 4 feet of the main trunk. Limbs over 3 inches in diameter require so long to heal over that there is much more danger of the grafts breaking out during strong winds, and wood-rotting fungi often attack.

In topworking pecans enough limbs should be grafted to produce a well-balanced top, but it is best to leave a few small branches to grow and support the roots until the grafts have grown for about a year. One should avoid leaving large branches, as grafts are likely to be broken out when they are removed.

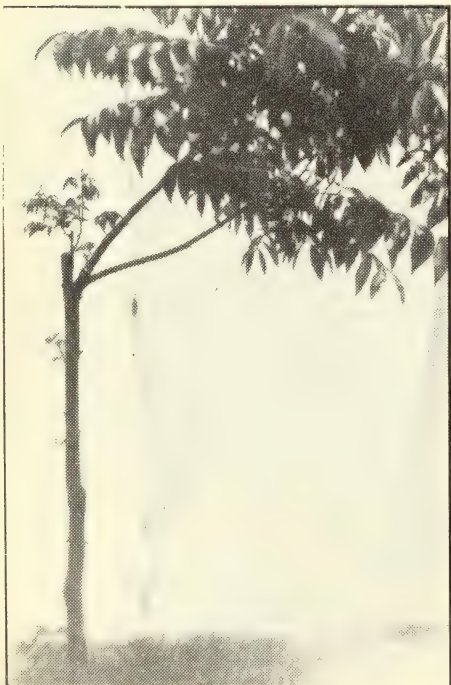


Figure 17. Small pecan tree 6 weeks after being bark grafted.

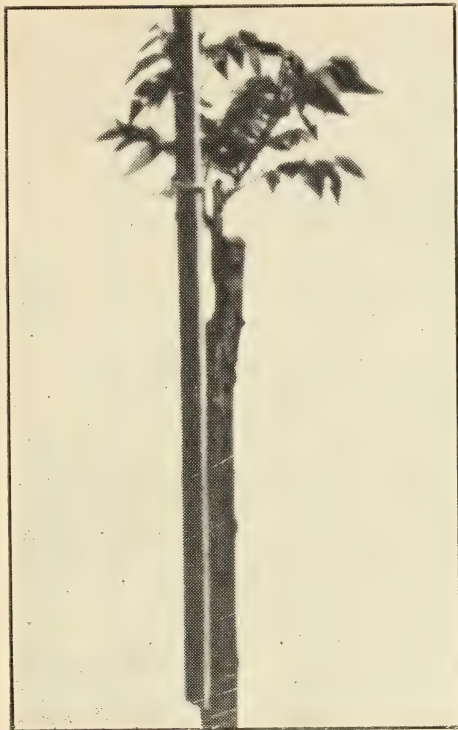


Figure 18. Same tree as in figure 17 after limbs and suckers have been removed and strip has been nailed in place to tie graft. In large topworked trees some limbs should be left for one year.

In topworking by use of the inlay side graft it is not necessary to cut out any limbs until the scions have begun to grow, but it is best to remove all larger limbs to prevent injury to growing scions by delayed removal of these limbs.

In using the patch bud for topworking larger trees the limbs are usually cut back to stubs in winter and buds inserted on large limbs, if the bark is pared down as mentioned under the instructions on the patch bud, but as with the inlay side graft, it is difficult to remove them later without injury to the growing bud.

Care of Topworked Pecan Trees. Pecan trees are often topworked in the

spring and then forgotten for the rest of the growing season. This usually results in the grafts being badly crowded by suckers from near the graft union on the stock and a serious loss of grafts by wind in the late summer and early fall.

About 3 to 4 weeks after the scions begin growth, the trees should be inspected carefully and all suckers removed from near the grafts. On any limb that the scion did not take, two or three suckers should be saved to be budded later in the summer. The month of July is usually a good time to do this, but it can be done as long as the bark will slip. If the budding is done as late as July 15, it is usually better not to try to force them until the following spring.



Figure 19. Small pecan tree topworked by the patch bud method in the summer 1941, buds forced in the spring of 1942, and tied to strips to prevent wind damage.

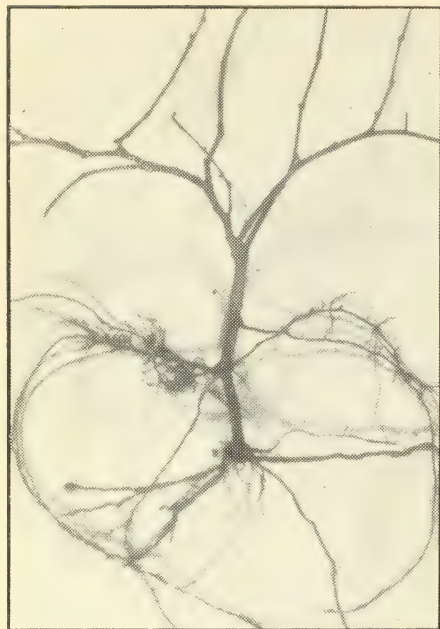


Figure 20. A well-rooted year-old grape cutting of the Champanel variety.

The process of removing suckers should be repeated two or three times during the first growing season and as often as they appear in later years.

As soon as the scion has grown as much as a foot or more, a small board such as a 1 x 2 or a 1 x 3, three or four feet long, should be nailed on to the limb grafted. Fasten securely with two nails and let the board extend about 3 feet beyond where the limb was cut, then tie the growing graft to it to prevent blowing out during strong winds. The graft should be kept tied to this board as it grows. Figures 17, 18, and 19 illustrate this method of protection from wind injury. Some advise pinching back all scions to prevent too long growth the first year as a protection against wind, but the writer prefers to let the desirable scions grow uninterrupted and

protect them from wind by the above method.

Wind damage can be reduced somewhat by keeping the scion cut back so that it will not grow over 2 or 3 feet the first year, but there will be some loss by wind, and trees develop less rapidly.

If two or more scions are placed in one limb and both take, one should usually be removed after about a year, as two branches growing too close together will produce weak crotches that are likely to split.

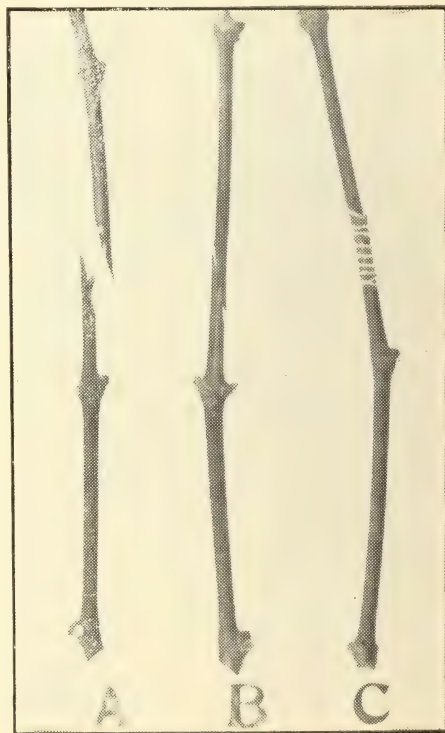


Figure 21. Steps in whip grafting grape cuttings. After the graft is made and wrapped as in C they are treated as hardwood cuttings, but be sure that the graft union is planted deep enough in the soil to prevent its drying out.

Methods of Propagating Small Fruits

Figs. Figs are readily propagated from hardwood cuttings. They are made during the dormant season from well-matured wood of the previous season's growth. The cutting should be 6 to 9 inches long, and the basal cut should be just below a bud, as it is from this position on the stem that roots arise most readily. If the cuttings are made in the fall or early winter, they will have to be stored in moist sand or moss in a cool place until spring. If made in late winter or early spring, they may be planted directly into the nursery row. Plant 8 to 10 inches apart and leave only one bud above the soil. Press the soil very firmly around the base of the cuttings. They may also be propagated by mound

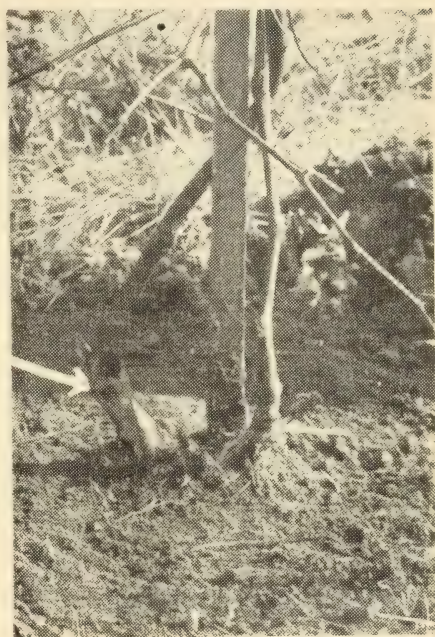


Figure 23. Same vine as in figure 22, showing bud unions. One of the vines will be removed at pruning time.



Figure 22. Concord grape chip budded on a two-year-old Dog Ridge stock, one year after being budded.

layering when there are small shoots arising from near the ground level.

Grapes. Most bunch grapes can be propagated readily from hardwood cuttings. They are made and treated very similarly to fig cuttings, described above. Figure 20 shows a well-rooted year-old cutting ready to be planted in the vineyard. For many of the common varieties it is desirable to graft or bud on a vigorous rootstock. The Dog Ridge variety makes a good rootstock which can be propagated by hardwood cuttings. The desired variety may be whip grafted on these cuttings when they are made in late winter as shown in figure 21. In this case they are then treated just like cuttings, but be sure that the graft union is planted deep enough to prevent any drying out. Do not wax.

One may also chip bud cuttings after they have rooted. The best time to do this is in late summer and mound them with soil to keep the bud moist. They are cut back and forced the following spring. Figures 22 and 23 show a Concord vine one year after being chip budded on a Dog Ridge stock. In February and early March, rooted Dog Ridge vines may be either whip grafted or, if they are large, cleft grafted just below the ground and mounded with soil, leaving one bud exposed on each scion. In budding or grafting on to rooted vines it is necessary to keep all suckers removed from the stock to prevent them from crowding out the scion variety. This will require several careful inspections during the first growing season.

Many varieties grafted on Dog Ridge roots will be much more vigorous, bear heavier crops, and live longer than when on their own roots.

Muscadines (including the Scuppernong variety) root very poorly from cuttings and must be propagated by layers. To make layers, take a cane and cover a portion of it with soil in late summer, and it will root by winter, after which it can be removed and treated as a rooted cutting. Long canes can be covered at several places and roots will be formed at each place covered. See figure 2. They should be covered deep enough to stay moist all of the time. Sometimes an old arm with several young canes growing on it can be covered, having each cane extending above the soil as in figure 24. In this way a plant can be had from each young cane.

Quince. Most quinces root readily from hardwood cuttings. Take cuttings from the past season's growth in January and February; treat as grape and fig cuttings.

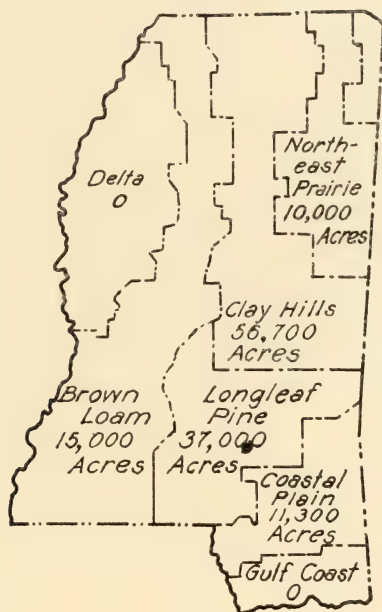
Blackberry. The roots of blackberries live for many years, but the canes live only 2 years. These canes sprout each spring from crowns, and suckers come from roots at various distances from the parent plant. Plenty of new plants can usually be obtained by digging up these suckers the following winter. Another method is to dig roots $1/4$ inch or more in diameter in the winter or early spring, cut these roots into pieces 3 to 4 inches long, and plant horizontally in trenches about 3 inches deep. These will sprout and by fall should become strong plants with good root systems.

Dewberry. This group includes the Boysenberry and Youngberry, and propagation is done by tip layering as in figure 3. In October the tip of the cane is covered with a little soil, and it will root within a few weeks. A bud or crown is formed from which the new plant develops (figure 4). When ready to plant, only a few inches of the old cane is left, which serves as a marker when the plant is set. These rooted tip layers will produce a good crop the second year after planting.

Strawberry. Strawberries are propagated from runners, which most varieties produce rather abundantly. The runners take root at the nodes, forming a new plant. These new plants are dug and set into the field either in the fall or late winter and early spring.

Peanuts for Oil

A WAR CROP FOR FARMERS
IN HILL AREAS OF MISSISSIPPI



1943 PEANUT GOALS BY TYPES OF FARMING AREAS

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director

Peanuts in the War Effort

To help meet wartime needs of this country and its allies for vegetable oil, a large increase in the production of peanuts for 1943 is urged. As in any other rapidly expanding enterprise involving new areas and inexperienced growers, peanut producers in 1942 were faced with many difficult problems in production and disposal. As a result of 1942 experiences and the much more favorable price announced by the Department of Agriculture, peanut producers should secure substantially larger yields and larger returns from peanuts in 1943 than in 1942.

Farmers in Mississippi and other Southern states are being asked to increase peanuts greatly, because of the acute need for vegetable oil and because there is a large acreage of land suitable for peanuts. In addition, southern oil mills have the capacity to crush the additional tonnage, whereas crushing and storage facilities are badly crowded in the principal soybean producing states.

This report summarizes the experiences of a selected sample of farmers who produced Spanish peanuts for oil in 1942, experiment station research findings, and the opinions of county agents and other local agricultural workers. The information on the 1942 experience of producers was obtained mainly in the Clay Hills Area, but it is believed the recommendations and conclusions are generally applicable to the Longleaf Pine and Coastal Plain Areas as well as to the counties in the Clay Hills.

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Peanuts for Oil: A War Crop

By PAUL S. McCOMAS, J. F. O'KELLY,
and FRANK J. WELCH

Vegetable oils, in addition to their edible uses, are now of vital importance in the manufacture of industrial products and munitions. Before World War II, a large part of the peacetime supply of vegetable oils was imported from Asia, South America, and the Pacific islands. War in the Pacific and the shortage of shipping facilities have almost completely cut off this supply. In order to meet urgent wartime requirements and build up badly needed reserves, farmers are urged to produce more fats and oils in 1943. Southern farmers can perhaps make their greatest contribution to this cause by increasing the acreage devoted to peanuts and soybeans.

The United States production goals for peanuts call for a minimum of 5½ million acres—an increase of 49 percent over the estimated 3,690,000 acres harvested in 1942. Mississippi farmers have been requested to grow a minimum of 132,000 acres, an increase of 120 percent over the estimated 60,000 acres harvested in 1942. This sharp increase in the production of peanuts for both the Nation and the State is a vital part of the war production program for 1943.

Peanuts, a War Goal Crop

Individual farm acreage goals are being established for certain war crops. When a farmer has accepted a war crop goal he is subject to a penalty if he does not plant at least 90 percent of his goal acreage. In the case of peanuts the penalty is at the rate of \$15 for each acre below 90 percent of the goal. For

example, if a farmer has accepted a goal of 5 acres of peanuts and plants 4 acres, he will be subject to a penalty of \$7.50 (4.5 acres, which is 90 percent of his goal, minus 4 acres equals one-half acre and at \$15 per acre this would result in a penalty of \$7.50). The penalties will be deducted from certain Agricultural Adjustment Administration payments.

Area and county goals were established on the basis of suitability of soils and facilities for producing war crops. The peanut goals by type of farming areas and counties are presented in table 1.

Peanut Production In Mississippi

Before World War II, peanuts for oil were chiefly a by-product of the edible peanut industry. In 1942, southern farmers almost doubled peanut production in response to patriotic appeals of agricultural leaders and price supports. In making this tremendous increase, it was necessary to extend commercial peanut production into many areas not formerly growing peanuts on a commercial scale. As a result, much of the 1942 production of peanuts was obtained in "new" peanut areas.

Peanut production in Mississippi has consisted largely of patches for family use. In 1941 there were about 27,000 acres of peanuts in the State and of this total only about 2,000 acres were produced on farms with peanut allotments. Unlike farmers in the sandy soil areas of the other Southeastern states, Mississippi farmers had not become interested in peanuts as a cash crop or as a feed crop. This lack

Mississippi Agricultural Experiment Station in cooperation with the Bureau of Agricultural Economics U. S. Department of Agriculture.

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of interest is perhaps attributable to relatively high cotton and corn yields on the sandy soils of Mississippi as compared to similar areas in the other Southeastern states than to a lack of soils suitable for peanuts.

With proper cultural practices, farmers in the Clay Hills, the Longleaf Pine, and the Lower Coastal Plain Areas of Mississippi could obtain peanut yields comparable with those in the commercial areas of Georgia and Alabama.

Table 1. Peanut goals for 1943 by areas and counties ^{1/}
Peanuts for oil and edible nuts

Area and county	Acreage goal 1943	Area and county	Acreage goal 1943
Brown Loam		Northeast Prairie	
Adams	0	Alcorn	0
Amite	2,000	Chickasaw	1,200
Carroll	0	Clay	1,000
Claiborne	0	Lee	2,100
Copiah	1,500	Lowndes	1,200
DeSoto	0	Monroe	2,500
Franklin	1,000	Noxubee	1,000
Grenada	1,000	Oktibbeha	0
Hinds	500	Prentiss	1,000
Holmes	500		
Jefferson	0		
Lincoln	3,000		
Madison	0	Longleaf Pine	
Panola	500		
Pike	3,000	Covington	4,000
Tate	0	Jasper	2,000
Warren	0	Jeff Davis	4,500
Wilkinson	0	Jones	5,000
Yalobusha	2,000	Lamar	2,000
Yazoo	0	Lawrence	3,000
		Marion	3,500
Clay Hills		Rankin	2,500
Attala	2,500	Simpson	4,000
Benton	1,000	Smith	2,500
Calhoun	1,000	Walthall	4,000
Choctaw	2,800		
Clarke	2,500		
Itawamba	3,500		
Kemper	3,500		
Lafayette	2,500		
Lauderdale	4,000		
Leake	5,000	Coastal Plain	
Marshall	3,000		
Montgomery	2,500	Forrest	1,500
Neshoba	6,000	George	1,200
Newton	4,000	Greene	1,100
Pontotoc	2,500	Pearl River	2,500
Scott	500	Perry	1,500
Tippah	0	Stone	1,000
Tishomingo	1,500	Wayne	2,500
Union	1,000		
Webster	2,000		
Winston	4,400		

^{1/} Peanut goals were not established for the Delta and the Gulf Coast.

Table 2.—Comparison of vegetable oil production from cotton and peanuts, Clay Hills Area, Mississippi

Item	Unit	Cottonseed	Spanish peanuts
Yield per acre	Pounds	450 ^{1/}	700 ^{2/}
Oil content	Percent	15.5	30.5
Oil yield per acre	Pounds	69.8	213.5
Oil yield per hour of man labor used....	Pounds	.63	.292

^{1/} Seed from a normal yield of 250 pounds of lint.

^{2/} Estimated normal yield with reasonably good practices. With the average 1942 State yield of 510 pounds of nuts, the oil yield per acre is about 156 pounds for Spanish peanuts.

In addition, it appears that peanuts might efficiently replace part of the corn acreage on farms on the sandy coastal plain soils. The cost of producing pork for family use could be reduced through hogging-off peanuts, with normal yields and prices. However, since most farmers do not have adequate fences for hogs, this development may not be practical for the duration of the war. Furthermore, in view of a prospective price of \$128 per ton, it will likely be more profitable for farmers to sell peanuts for oil than use them for livestock feed.

Why Increase Peanuts

The question is often raised by agricultural leaders and farmers in the State as to the possibility of growing more cotton and utilizing the cottonseed for oil purposes instead of growing peanuts for oil. It is pointed out that this type of program would provide both fiber and vegetable oil for the war program. On the other hand, emphasis on the peanut production program is based on the following factors:

(1) Production of oil per acre and per hour of man labor is much greater for peanuts than for cotton (table 2). On the basis of oil production per hour of labor, peanuts are about five times as efficient as cotton, while on a per-acre basis the comparable figure is three to one.

(2) Peanut oil is considered superior to cottonseed oil when used for many edible purposes and is adapted to a wider variety of industrial uses.

(3) Farm land suited to peanut production generally produces cotton of the shorter staple lengths and the supply of short cotton is already in excess of visible needs for some time.

The 1942 Experience

Mississippi producers encountered many problems in producing and marketing the 1942 peanut crop. Due to lack of experience in producing peanuts on a commercial scale, most farmers followed poor cultural practices. Because of inferior seed, low seeding rates, unfavorable weather, and poor cultural practices, yields were generally quite low.

There are a number of things that farmers can do to increase the yields and profits from peanuts. In 1942 one of the major difficulties was the failure to obtain good stands. Farmers can improve this situation by saving good quality seed and following the recommendations of agronomists in regard to preparation of land, seed treatment, and planting procedure.

Another major difficulty was the failure to control grass and weeds. The labor required for keeping peanuts clean can be greatly reduced by using the proper cultivating practices as soon as the peanuts are out of the ground. Recommended practices are presented under Suggestions for Increasing Yields and Profits from Peanuts.

In 1942, Mississippi farmers planted an estimated 75,000 acres of peanuts or about three times the acreage usually planted. Due, however, to low prospective yields and uncertainties and con-

fusion in regard to pickers, markets, and prices, a considerable acreage was not harvested for nuts. The indicated average State yield was about 510 pounds per acre, but many farmers who obtained good stands reported yields of 800 pounds or more.

With low average yields and the prices that prevailed, peanut production was not generally profitable in 1942. Even with considerably higher yields, peanuts would not have been as profitable as other alternative enterprises, on the basis of \$82 per ton.

Improved Program For 1943

Most of the obstacles associated with the 1942 program are being removed. The objectionable two-price system has been eliminated. The United States Department of Agriculture has announced a single support price for all peanuts which will assure all growers of a price of 85 percent of parity. No distinction will be made between quota and excess peanuts. This price program means that farmers will be paid approximately \$128 per ton for peanuts. There will be variations from this price because of differences in quality and grade. The best grade of peanuts will bring more, and the low grades considerably less. With this price, many farmers will find it profitable to divert land and labor from other crops to peanuts provided they use good cultural practices.

The Department of Agriculture has taken steps to develop a more adequate program for providing the necessary peanut pickers and marketing facilities. A sufficient quantity of mechanical pickers has been manufactured. The difficulty in 1942 was in getting the machines in the hands of custom operators and on the job. There is every indication that this situation will be greatly improved in 1943. It is highly important to place all available pickers in the hands of custom operators at the beginning of the

season so farmers will be satisfied at planting time that they will have the services of custom threshers.

Cultural Practices and Labor Requirements

The low peanut yields obtained by many Mississippi farmers in 1942 are attributable in large part to inferior seed and poor cultural practices. Successful peanut production requires careful and prompt attention.

Experiences of farmers in 1942 and experiment station results indicate that peanuts should be planted on well-drained, light-textured sandy soils. Poorly-drained soils and those with a high percentage of clay should be avoided. On heavy soils, there is usually a heavy loss of nuts in digging and often some discoloration of the hulls. Furthermore, the problem of controlling grass and weeds is usually more serious on heavy soils than is the case with peanuts grown on light sandy soils.

Land Preparation, Planting

Thorough land preparation for peanuts is very important. It is preferable to prepare peanut land in the winter, well ahead of planting time, to speed up the decay of grass and litter and increase the moisture-holding capacity. Good results may be obtained by flat breaking or bedding. For Spanish peanuts, excellent results may be obtained by planting peanuts in a shallow furrow on flat-broken land. A straight shovel on a Georgia stock is a good implement to use in laying off the rows. The peanuts should be planted in the furrow with a planter so that the top of the seedbed is slightly below the ground level. By planting peanuts in this way, it is possible to run a harrow over the rows and cover grass and weeds without injuring the young peanut plants.

If peanut land is to be bedded, it is

desirable to prepare a low flat bed 2 or 3 weeks ahead of planting time. The bed may be opened with a straight shovel on a fertilizer distributor or a Georgia stock.

Peanuts should be planted in narrow rows (from 24 to 30 inches) with a spacing of about 6 inches in the row. Experimental work has shown that yields are somewhat higher in 24-inch rows, but grass and weeds are more difficult to control with ordinary equipment in the narrow rows. The peanuts should be planted in a shallow furrow and covered to a depth of $1\frac{1}{2}$ to 2 inches. To obtain a good stand on this basis, 50 to 60 pounds of Spanish peanuts in the hull would be required per acre. If planted in the hull, the peanuts should be soaked in water overnight and planted preferably while the soil is moist. Equally satisfactory results may be obtained by shelling the peanuts carefully and plant-

ing 25 to 30 pounds per acre. Planting should be done between April 15 and May 15.

Seed peanuts should not be shelled by a machine unless it is built for that purpose and operated carefully. Careless machine shelling damages the kernels and lowers germination. Shelled peanuts should be treated with a dust disinfectant to prevent seed rot or seedling blight. This is especially important for machine-shelled seed. Two percent Ceresan and other dust disinfectants are satisfactory for this purpose. The seed may be treated in a rotary barrel mixer such as is used in treating cottonseed. Use about 3 ounces of 2 percent Ceresan per 100 pounds of seed. Turn mixer slowly at least 150 times. The use of 5 percent Ceresan is hazardous and sometimes results in seed injury.

In 1942, a number of farmers reported planting peanuts by hand because

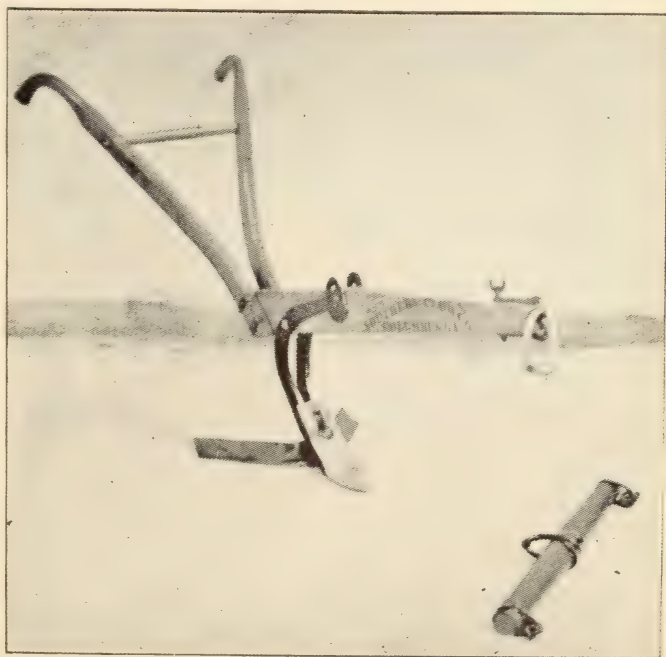


Figure 1. Scrape or heel sweep, familiar implement used in cultivating peanuts.

plates suitable for peanuts in the hull were not available. Most manufacturers of cotton and corn planters make plates suitable for planting peanuts in the hull as well as shelled peanuts.

Peanut Equipment

Farmers who bought Avery, Cole, and McCormick-Deering planters with duplex hoppers probably received at the time of purchase plates for planting both peanuts in the hull and velvet beans. Duplex hoppers can be obtained for the Avery, Cole, and McCormick-Deering planters at a cost of from \$7.50 to \$10.00.

Peanut plates and attachments necessary for satisfactory conversion of planters other than those mentioned above may be obtained through your local implement dealer. In ordering parts it is desirable to specify the type of planter, the model number, and if possible, the number of the particular part desired. Your local machinery dealer or county agent can provide the necessary information about converting planters and obtaining additional parts.

Cultivation should start as soon as most of the peanuts are out of the

ground. To keep down grass and weeds and reduce the labor of hoeing, it is very important to run a top-harrow or a weeder over the rows from two to four times, depending on the weather and the degree of infestation with grass and weeds. Injury to young peanut plants by running a harrow over the rows and partially covering the plants with dirt is usually negligible. On soils heavy enough for a crust to form after rains, it is sometimes necessary to break the crust to enable the young plants to come out again.

Nearly all the farmers interviewed used two-mule equipment in preparing the land and one-mule equipment for cultivating peanuts. Most of the practices followed up to harvest time were essentially the same as those used on cotton and corn. In general, peanuts were cultivated fewer times than cotton, and were chopped and hoed less than cotton but more than corn.

Harvesting operations usually extend over a period of about 2 or 3 months and require about 32 hours per acre. Digging and stacking, the most critical



Figure 2. Turning plow with wing removed for use in digging peanuts.



Figure 3. Placing peanuts on stack poles for drying.

operation in harvesting, requires timely performance if good yields of high quality nuts are to be obtained. The period for digging and stacking usually occurs in early September and this operation must be completed within about 3 weeks in order to prevent loss and deterioration of the nuts. This operation, on the average, requires approximately 25 man hours per acre and more than any other limits the acreage a family can handle.

In digging, the most common practice is to take the wings off a middlebuster or turning plow to plow out the peanuts, shake off the dirt by hand, and throw three or four rows together.

In most cases the peanuts are placed around the stack pole by hand as soon as the vines have wilted. However, about one-third of the farmers interviewed allowed the peanuts to remain in piles 2 or 3 days or until thoroughly dry, and then hauled them to the barn. This

reduced the labor required at digging time in September, but increased the labor at picking time, because of the extra time required for reloading and hauling to the picker. Barn curing is not advisable because of the danger of heating and deterioration in the quality of nuts.

At this time when the labor supply is a very important limiting factor on farms, it is desirable to consider the per-acre labor requirements of crops. Estimates of per-acre man labor requirements by operations for peanuts, cotton, and corn, are shown in table 3.

The threshing operation is usually performed 6 weeks or more after the peanuts are stacked. This operation requires very little time per acre and per ton, but considerable time is required to haul the peanuts to the picker and move the picker from one community to another. In many communities much time was lost in moving the picker from one farm to

Table 3.—Usual operations and man labor used per acre in producing peanuts, cotton, and corn, Clay Hills Area, Mississippi

Item	1942 Situation	1943 Situation—Normal yields		
	Peanuts	Cotton	Peanuts	Corn
	450 lb. yield	250 lb. yield	700 lb. yield	15 bu. yield
	Hours	Hours	Hours	Hours
Seedbed preparation	7.5	10.0	10.5	10.0
Put out fertilizer	1.5	2.0	2.0	—
Plant	1.5 ^{1/}	2.0	2.0	2.0
Cultivate	10.5	16.0	10.5	8.0
Hoe	10.0	20.0	10.0	5.0
Harvest (dig, shake and stack)	25.0	58.0 ^{2/}	27.0	7.0
Thresh	6.0 ^{3/}	—	7.0	—
Handle hay	1.0 ^{4/}	—	1.0	—
Market	3.0	2.0	3.0	—
Total	66.0	110.0	73.0	32.0

^{1/} Does not include shelling nuts planted.

^{2/} Cotton harvesting includes 52 hours for picking and weighing and 6 hours for loading and hauling to gin. Harvesting peanuts includes preparing and setting poles.

^{3/} In addition, contract thresher operator furnishes 2 man hours for threshing.

^{4/} When hay is baled the contract baler operator furnishes 2 man hours.

another or from one assembly point to another. Generally pickers were located on the farm of one of the growers and the adjoining producers hauled to the assembly point. The average distance peanuts were hauled was about 1½ miles.

There is a possibility for much more efficient utilization of pickers and lower custom charges to farmers through greater concentration of peanuts in adapted communities. With small scattered patches and low yields such as occurred in 1942, it is difficult to obtain enough tonnage per day for profitable operation of a picker. To alleviate the problem of obtaining custom operators for pickers, avoid high threshing charges, and present inefficient use of labor, it is suggested that peanuts be concentrated as much as possible within adapted communities. Isolated peanut producers should either interest some neighbors in growing peanuts or limit their production to the amount that can be picked by hand or with home-made threshers.

Fertilizer Practices

Although peanut production is known to deplete soils rapidly when both nuts and hay are removed, results from fer-

tilizer trials have varied widely, making it impossible to give clearcut fertilizer recommendations. The suggestions for fertilization which follow are to be taken, therefore, as the best that can be made in the light of available information and will be modified as further information is obtained.

Results from recent trials seem to justify the use of 500 pounds to the acre of dolomitic limestone ahead of peanuts regardless of the fertility of the soil. On moderately fertile to fertile soils (those which will produce 1000 to 1400 pounds of nuts to the acre), which were well fertilized for the previous crop this application of dolomitic limestone is all that should be necessary.

On average soil (those that will produce 600 to 800 pounds of nuts to the acre), the grower may use in addition to the limestone, a mixture of 100 pounds of 20 percent superphosphate and 50 pounds of muriate of potash, or 200 pounds of 0-14-7.

Poor soils (those that will produce 400 to 500 pounds of nuts to the acre) will need, in addition to the above, the equivalent of 50 pounds of nitrate of soda. It is doubtful, however, if peanut growing on such soils will be profitable or that

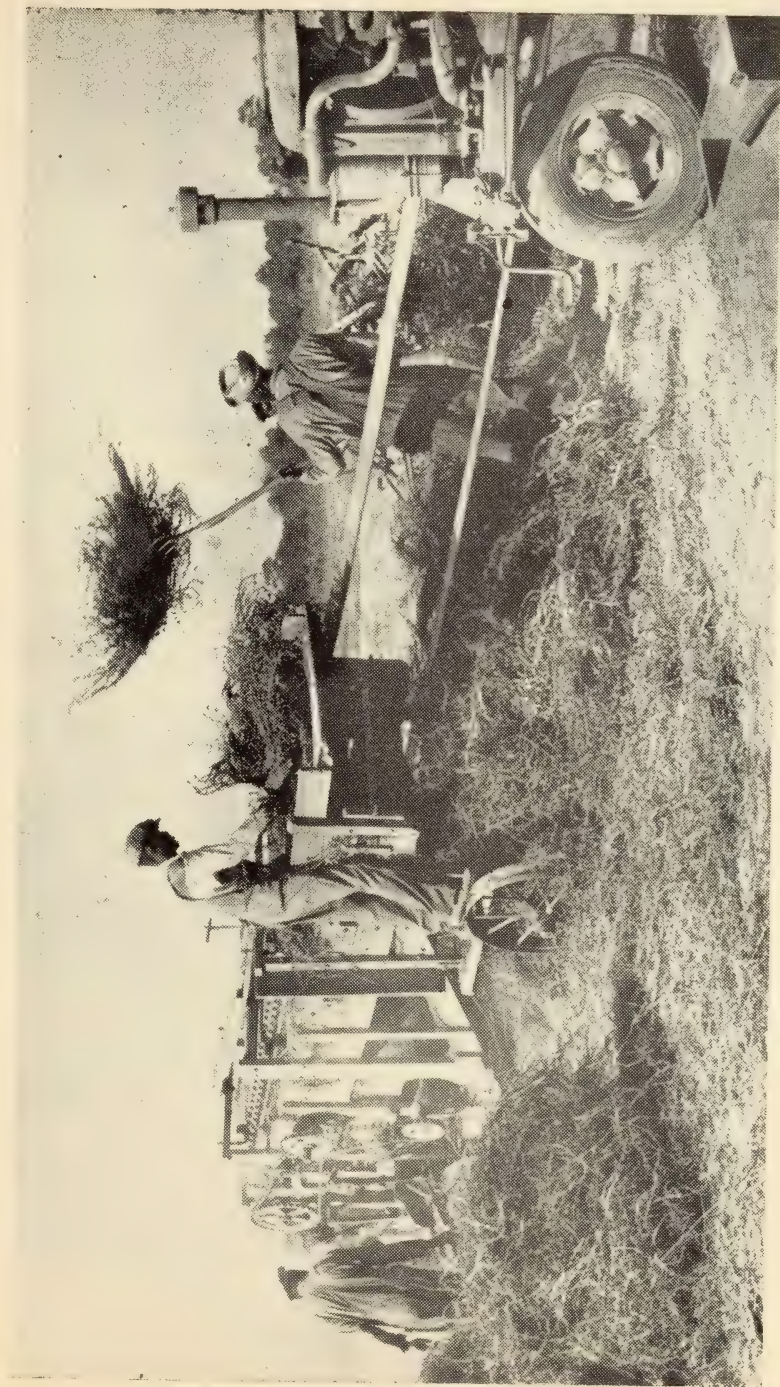


Figure 4. Peanut picker used in separating nuts from vines after the curing process.

the war effort will be materially aided thereby when the present labor and fertilizer shortages are considered.

Where basic slag is available and dolomitic limestone is not, the slag can be used instead of limestone and it will also supply the needed phosphorus.

Comparison of Incomes from Peanuts, Cotton, and Corn

Faced with less labor and fertilizer, and with the prospect of more profitable returns from other crops, it is not surprising that farmers in new peanut areas have been somewhat reluctant to divert scarce factors of production to a new enterprise. On the basis of 1942 prices and yields, cotton has a decided income advantage over other crops on most farms in the hill areas.

With the prospective 1943 price and the estimated normal yield for peanuts, the income advantage of cotton over peanuts is greatly reduced and farmers with low cotton yields may find it profitable to substitute peanuts for cotton in 1943. In general, however, farmers are likely to utilize their available labor to plant their full cotton allotment, and will not plant peanuts unless more labor is available than is required for cotton.

Peanuts demand about two-thirds as much labor as cotton and compete directly with cotton for labor. Since only about 25 percent of the available cropland can be used for cotton, much non-cotton land is still available for peanuts. From the standpoint of cropland, peanuts compete primarily with corn, oats, and hay for the 75 percent of the cropland not in cotton. From the labor standpoint, peanuts compete primarily with cotton and corn.

Estimates of per-acre gross cash income, expenses, and per-acre returns to land and management for peanuts, cotton, and corn are presented in table 4.

Estimates of yields, incomes, and costs

are necessarily based on averages for a group of farms and are useful only as a rough measure of the relative advantage of crops on an area basis. The same procedure may be used by producers in determining the relative advantage of crops on specific farms, but yields, costs, and prices applicable to that farm should be used in making the determination.

Based on estimated 1942 yields of 450 pounds for peanuts, the average yields as shown by records from farmers interviewed and estimates of 11 county agents in the Clay Hills Area—the estimated per-acre return to land and management (gross income of crop minus specified expenses) is 5 cents for peanuts. Thus, on the basis of per-acre returns to land and management, peanuts were much less profitable than cotton and corn in 1942. Peanut yields were very low in 1942 due to unfavorable weather and poor cultural practices, whereas cotton and corn yields were above average.

With normal yields and a price of \$120 per ton for peanuts, the per-acre return to land and management is \$18.97 for peanuts, \$23.25 for cotton, and \$8.45 for corn (table 4). In comparing returns from peanuts with other crops (table 4), a conservative price of \$120 per ton was used to make allowance for some peanuts falling in lower grades. Using the announced price of \$128 per ton, peanuts compare somewhat more favorably with cotton and give a per-acre return to land and management of \$21.77. With this price, most farmers in this area would probably find it profitable to divert land from corn to peanuts. On some farms with low cotton yields (225 pounds or less), the substitution of peanuts for cotton would be profitable, provided good cultural practices are used on the peanuts.

On many family farms, labor is now relatively more scarce than land, and one of the most important considerations



Figure 5. Mule-drawn hay baler, baling peanut hay. Peanuts yield approximately twice as many pounds of hay as of nuts.

Table 4. Relative cash value and specified expenses of various crops, per acre, Clay Hills Area, Mississippi.

Item	Unit	Peanuts for oil		1943 situation ^{1/}					
		1942 situation		Cotton		Peanuts for oil		Corn grain	
		Nuts	Hay	Lint	Seed	Nuts	Hay		
Yield	Pounds	450	700	250	450	700	1000	840	
Price per pound	Cents	4	0.5	19	2.5	6	0.5	2	
Gross cash value	Dollars	21.50		58.75		47.44 ^{2/}		18.80 ^{3/}	
Man labor requirements	Hours	66.00		110.00		73.00		32.00	
Direct cash expenses:	Dollars								
Fertilizer ^{4/}	do	3.00		4.50		3.00		0	
Seed ^{5/}	do	2.60		2.00		3.60		.20	
Sacks	do	.50		—		.75		—	
Contract threshing ^{6/}	do	2.70		—		4.20		—	
Cotton ginning ^{7/}	do	—		2.85		—		—	
Poles, nails and misc.	do	.30		—		.48		—	
Total	do	9.10		9.35		12.03		.20	
Return over direct cash expenses									
Per acre	Dollars	12.40		49.40		34.97		18.60	
Per hour	do	.19		.45		.48		.58	
Other specified expenses:									
Man labor ^{8/}	Dollars	8.25		20.40		10.95		4.80	
Mule labor ^{9/}	do	3.35		5.00		4.30		4.60	
Machinery	do	.75		.75		.75		.75	
Total specified expenses	do	21.45		35.50		28.03		10.35	
Per-acre return to land and management	do	.05		23.25		18.97		8.45	

^{1/} Yields which might be expected with normal weather conditions and good cultural practices.

^{2/} Incentive payments are not included.

^{3/} Includes \$2.00 per acre for grazing.

^{4/} 200 pounds 4-8-4 on peanuts; 300 pounds of 4-8-4 on cotton; no fertilizer on corn.

^{5/} Cash or cash equivalent, assumes all peanut seed purchased in 1942 and all seed saved for 1943; cottonseed one-third purchased, two-thirds home-grown; one-half of seed corn purchased; one-half home-grown.

^{6/} \$12.00 per ton includes laborers furnished by thresher operator.

^{7/} 30 cents per cwt. of seed cotton; \$1.50 per bale for bagging and ties.

^{8/} Average cost of labor for peanut enterprise in 1942 was 12½ cents per hour; the assumed rate for 1943 is 15 cents per hour for all operations except cotton picking; cotton picking \$1.50 per cwt. seed cotton.

^{9/} Mule labor estimated at 10 cents per hour.

in determining which enterprises are most profitable is the return per hour of man labor required to produce the adapted crops. Based on normal yields and estimated 1943 prices, returns over direct cash costs per hour of man labor required are 48 cents for peanuts, 45 cents for cotton, and 58 cents for corn. Thus with expected 1943 prices and estimated normal yields, peanuts compare favorably with cotton on returns per hour, but are less profitable than cotton on the basis of per-acre returns. Agricultural Adjustment Administration cotton pay-

ments and prospective peanut incentive payments are not included in income comparisons.

Yields and prices vary from farm to farm and from year to year. There is a wide variation in the farm-to-farm ratio of peanut yields to cotton yields and in the per unit cost of producing peanuts relative to comparable costs inherent in cotton production. In determining the most profitable combination of enterprises, the farmer should use the normal yields and the expected prices and costs applicable to his farm.

In an attempt to provide a basis for determining the relative profitability, under different yield and price relationships, net returns to land and management have been calculated, using varying yields and prices for each crop (table 5). Costs of ginning, contract threshing, cotton picking and other harvest labor have been varied with varying yields. Other costs were assumed to remain constant.

How to use table 5. Let us assume that a comparison is desired of the relative income to land and management, on

a farm with a 200-pound lint cotton yield and a farm price of 19 cents, with peanuts yielding 600 pounds and a farm price of 6 cents per pound. Follow the cotton line indicating a 200-pound yield of cotton across to the column headed 19 cents; here the net income to land and management is \$13.99. Then follow the peanut line indicating a 600-pound yield across to the column headed 6 cents; here the estimated net income is \$13.01. On the basis of these yields and prices, returns per acre of cotton are 98 cents larger than for peanuts.

Table 5. Estimates of per-acre returns to land and management for peanuts, cotton, and corn with varying yields and prices; Clay Hills Area of Mississippi.

Yield per acre	Peanuts ^{1/}			
	Price per pound			
	.04	.06	.07	.08
Pounds	Dollars	Dollars	Dollars	Dollars
300	-10.89 ^{2/}	-4.89	-1.88	1.11
400	-6.92	1.08	5.08	9.08
500	-2.96	7.04	12.04	17.05
600	1.01	13.01	19.01	25.01
700	4.97	18.97	25.97	32.97
800	8.94	24.94	32.94	40.94
900	12.90	30.90	39.90	48.90
1000	16.86	36.86	46.86	56.86
1100	20.83	42.83	53.83	64.83
1200	24.79	48.79	60.79	72.79

Yield per acre	Cotton			
	Price per pound			
	.16	.19	.22	.25
Pounds	Dollars	Dollars	Dollars	Dollars
150	.59	5.09	9.59	14.09
200	7.99	13.99	19.99	25.99
250	15.75	23.25	30.75	38.25
300	23.33	32.33	41.33	50.33
350	30.91	41.41	51.91	62.41
400	38.49	50.49	62.49	74.49
450	46.07	59.57	73.07	86.57
500	53.65	68.65	83.65	98.65

Yield per acre	Corn			
	Price per bushel			
	.90	1.00	1.10	1.20
Bushels	Dollars	Dollars	Dollars	Dollars
10	.80	1.80	2.80	3.80
15	5.15	6.65	8.15	9.65
20	9.40	11.40	13.40	15.40
25	13.75	16.25	18.75	21.25
30	18.10	21.10	24.10	27.10

^{1/} Incentive payments are not included.

^{2/} A - (minus) denotes a loss.

From the standpoint of per-acre returns, this analysis indicates that peanuts can be substituted profitably for corn on farms with corn yields up to 23 bushels provided the land will produce 700 pounds or more of peanuts, by assuming a price of \$120 per ton for peanuts, 19 cents per pound for cotton, and \$1.12 per bushel for corn. Peanuts may be substituted for cotton on farms with yields up to 225 pounds provided the peanut yield is in excess of 700 pounds. Thus, in the case of cotton, only farmers with yields below average can afford to reduce cotton in favor of peanuts, whereas peanuts may be substituted for corn except on farms with corn yields 50 percent or more above average—provided yields are normal or above (700 pounds is assumed normal peanut yield.)

Farmers extremely short on labor may find it more profitable to grow crops with smaller labor requirements than peanuts. Under these conditions, returns per hour of labor may become more significant than returns per acre of cropland.

Peanuts in the Farm Organization

Peanuts do not blend well into the farm organization of most cotton farms because of the conflict with cotton for labor during the spring and fall labor peaks. Competition for labor is more

serious than the competition for land on many farms in the Clay Hills Area. Many farmers, however, have underutilized labor and unutilized land. In addition, the equipment used in cotton and corn production is adequate for planting and cultivating peanuts.

A Typical Farm

A considerable portion of the farms in the Clay Hills Area are one family, two-mule cotton farms, ranging in size from about 25 to 40 acres of cropland per farm. Perhaps the most usual farm in this group is a cotton farm consisting of about 30 acres of cropland with about 8 acres of cotton, 12 acres of corn, 6 acres of hay, 1 acre of miscellaneous crops, and 3 acres tillable idle land, table 6.

This typical cropland organization is used to illustrate the effect of peanuts on farm income and labor needs. The acreage of crops that can be handled by a family is limited, primarily, by the amount of cotton that can be picked. Most families handle only about 8 to 10 acres of cotton because of the high labor requirement in September and October. During the remainder of the year family labor is greatly under-utilized.

The great need on these farms is enterprises that will provide a profitable utilization of labor during off-peak periods. In this respect, peanut enterprise does not "fill the bill" because of the

Table 6. Cropland organizations, family farms, Clay Hills Area, Mississippi.

Item	Unit	Most usual present organization Two-mule cotton	Alternative organizations	
			Two-mule cotton with 3 acres peanuts	Two-mule cotton with 6 acres peanuts
Total land in farms	Acres	60	60	60
Cropland	do	30	30	30
Cropland organization:				
Cotton	Acres	8	8	5
Corn	do	12	12	12
Hay	do	6	6	6
Sorghum	do	.5	.5	.5
Garden	do	.5	.5	.5
Tillable idle land	do	3	—	—
Vetch (after cotton)	do	(4)	(4)	(4)
Peanuts	do	—	3	6

sharp conflict with cotton for labor during September. Nevertheless, this enterprise seems to have possibilities for utilizing idle land and under-utilized labor on small cotton farms and as a substitute cash crop for cotton.

Peanuts Utilize Idle Cropland and Under-Employed Labor

Farmers on many small cotton farms, after planting their full allotment of cotton have some unutilized land and under-utilized labor. On such farms a small acreage of peanuts may be added, without disturbing the remainder of the organization. With recommended prices and incentive payments a peanut enterprise will materially increase the farm income provided the small acreage can be threshed without incurring an unduly high cost. Threshing costs can be kept within reasonable limits if several farmers in a local community grow peanuts and haul them to a central point.

The substitution of 3 acres of peanuts for idle land, other enterprises remaining the same, and with yields and prices shown in table 3, would increase the net cash income (gross cash income less cash expenses except labor) approximately \$100 (table 7). It is estimated that with the present organization no labor would need to be hired, whereas, with the ad-

dition of 3 acres of peanuts an estimated labor expense of \$20 would be incurred in September and October, table 7. The total estimated labor needs for the present organization are 228 days or about 22 days less than for the organization with 3 acres of peanuts.

About one-fourth of the management units in this area have less than 20 acres of cropland and 5 acres or less of cotton. Most of the families in this category have enough labor to handle 2 to 5 acres of peanuts even during the harvesting season. Peanuts would replace feed crops and idle cropland. This substitution will increase income more than enough to offset additional necessary feed purchases.

Substitution of Peanuts for Cotton

Many family farms in this area probably do not have enough labor to produce more than 3 acres of peanuts in addition to their allotted cotton acreage, because of the sharp conflict of peanuts and cotton for labor during the harvesting season and the need for timeliness in peanut digging. Hence such farmers cannot be expected to grow a large acreage (5 or more acres) of peanuts unless returns from peanuts compare favorably with cotton.

Table 7. Comparison of estimated cash incomes on family cotton farms, Clay Hills Area, Mississippi, 1943.^{1/}

Item	Most usual present organization Two-mule cotton	Alternative organizations	
		Two-mule cotton with 3 acres peanuts	Two-mule cotton with 6 acres peanuts
	Dollars	Dollars	Dollars
Gross cash income	612	753	721
Cash expenses ^{2/}	254	290	300
Net cash income ^{3/}	358	463	421
Estimated hired labor	—	20	28
Estimated labor needs:	Days	Days	Days
Total	230	250	240
Hired	0	10	14

^{1/} These estimates are based upon unpublished data from farm management studies in the Clay Hills Area.

^{2/} Does not include hired labor.

^{3/} Does not include value of farm grown products used in home.

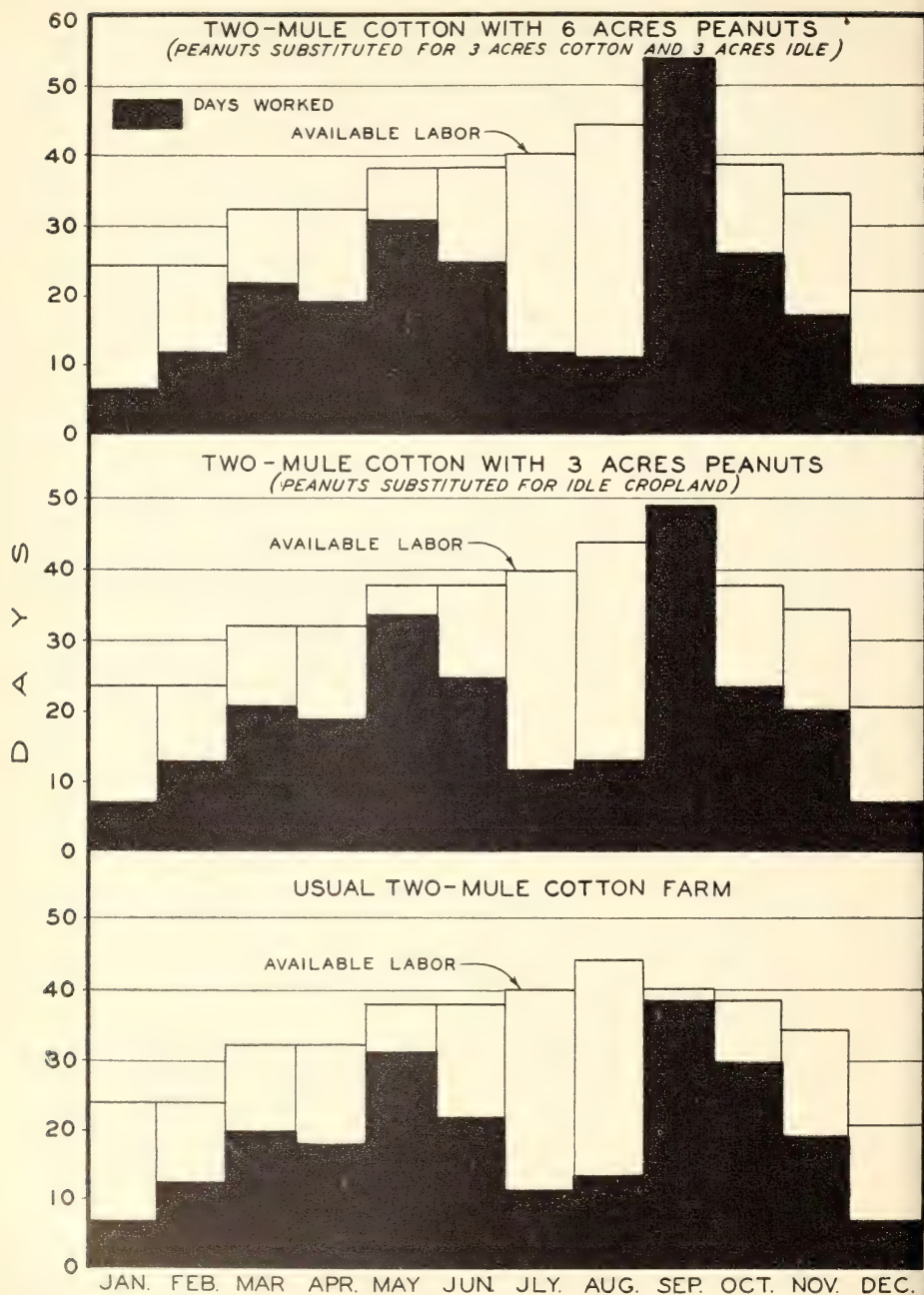


Figure 6. Usual number and distribution by months of man work days and the estimated available working days with a labor force equivalent to two men; lower section, 8 acres cotton, 12 acres corn, 7 acres other crops, 3 acres idle, no peanuts; middle section, 3 acres peanuts substitute for idle cropland; upper section, 6 acres peanuts substituted for 3 acres cotton and 3 acres idle cropland.

The substitution of 3 acres of peanuts for 3 acres of cotton, other enterprises remaining the same, and with yields and prices shown in table 3, would decrease net cash income (gross cash income less cash expenses except labor), about \$42 (table 7).

Total labor requirements would be reduced about 11 days by this substitution, whereas, labor requirements during September would be increased about 4 days (figure 6). Hence, the cost of hired labor would be increased about \$8 unless cotton picking is postponed and spread over a longer period than is customary.

In brief, this analysis indicates that:

(1) Small cotton farmers with idle cropland and a surplus of labor could profitably grow up to 3 acres of peanuts provided the small acreage can be threshed and marketed without incurring an unduly high cost.

(2) The substitution of peanuts for cotton is worthy of consideration on farms where normal cotton yields are below 225 pounds.

RUNNER PEANUTS

Although this study applies primarily to Spanish peanuts, it should not be assumed that runner peanuts do not merit consideration. The runner types where planted early and given adequate attention will usually produce more nuts to the acre than Spanish peanuts. The runners may be left in the field much longer than the Spanish without serious danger to the nuts and may sometimes be harvested after the peak period for cotton picking. They are well adapted for hogging-off because they are slow to sprout and deteriorate. In addition they will produce satisfactorily in somewhat wider rows than is the case with Spanish. On the other hand they are lower in oil content and in price and are not as certain to produce a crop from late plantings as is the case with Spanish.

Suggestions for Increasing Yields and Profits from Peanuts

(1) Peanuts should be planted on well-drained sandy soils.

(2) The land should be broken or ridged and prepared well ahead of planting time.

(3) Rows should be from 24 to 30 inches and hills about 6 inches apart for Spanish peanuts. It is important to have narrow rows, close spacing, and good stands for highest yields with peanuts.

(4) Use best grade seed obtainable.

(5) Spanish peanuts should be soaked in water overnight if they are to be planted in the hull and should be planted in moist soil at the rate of about 60 pounds per acre. Use of shelled peanuts is recommended where they can be shelled by hand or by a machine built and operated especially for seed peanuts. For shelled peanuts, about 30 pounds of seed per acre is suggested.

(6) If peanuts are shelled some time in advance of planting it is advisable to treat the seed with a dust disinfectant to prevent seed rot and damping off. Treatment of machine-shelled seed is especially important. Two percent Ceresan and several other dust disinfectants are available and satisfactory. The use of 5 percent Ceresan sometimes results in seed injury. Consult your county agricultural agent for the amounts to use and how to use it.

(7) Early planting, April 15 to May 15, is desirable.

(8) Cultivation should start as soon as most of the peanuts are out of the ground. To keep down grass and weeds and reduce the labor of hoeing, it is very important to run a section harrow, a top-harrow, or a weeder over the peanuts from two to four times, depending on the weather and the amount of grass and weeds. If these operations partially cover the plants they will emerge if the

soil is a light-textured sandy loam. On heavier soils a crust forming after a rain would have to be broken for the young plants to re-emerge. Later cultivation with sweeps and shovels to keep down weeds and work the soil toward the plants is desirable.

(9) Timely digging is very important for Spanish peanuts. Digging should begin as soon as most of the nuts are fully developed and the inside of the shell begins to color and show dark-colored veins. If digging is delayed the nuts will soon begin to sprout.

(10) A turning plow or middle-buster with the wings removed is a satisfactory implement to use for digging peanuts.

(11) Peanuts should be "shaken out" to remove dirt, and should be piled in windrows to wilt. Ordinarily, stacking may be started within 4 or 5 hours after the digging is finished.

(12) The peanuts should be placed around a 6- to 8-foot stack pole with crossbars nailed on about 18 inches above the ground. In stacking, the nuts should be placed in the center to prevent weath-

ering and grass should be used to cap off the stack.

(13) For most economical threshing and marketing, peanut production should be concentrated as much as possible within communities that are well adapted to peanuts. Farmers located a considerable distance from other peanut producers should plant a sufficient acreage to make it economical for a thresher to be brought to his farm or should plant only the acreage that can be picked by hand.

(14) Peanut producers should be carefully informed in regard to marketing procedure and grading technique. An orderly marketing program should be worked out so that producers can sell their peanuts without delay. As each community is "picked out," a certain day or period should be assigned for marketing their peanuts.

(15) Full-time buyers should be established in counties that produce 300 or more tons of nuts. In the less important peanut counties a local citizen should be trained, and then be available to receive peanuts along with his regular business.

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BEEF CATTLE PRODUCTION



Compiled by H. O. WEST, Coordinator Research Information
Jointly Representing Mississippi State Vocational Board
and : Mississippi Agricultural Experiment Station

MISSISSIPPI STATE COLLEGE
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BEEF CATTLE PRODUCTION

Compiled by H. O. WEST*

Beef cattle production seems to have agricultural possibilities in Mississippi. Much of the land area of the State is unsuitable for profitable row-crop production due to steep slopes, erosion, poor drainage, and overflow. There seems to be a need for the profitable utilization of such land as may not be suitable for profitable row-crop culture. No other enterprise seems more adapted to the utilization of unadapted row-crop land than livestock.

In addition to the need for a means of economically utilizing non-productive or unprofitable acres, the need for cash income in addition to that from cotton is pressing. The increased production of livestock offers an opportunity for a cash market for grain and forage produced, to add fertility to the soil, to utilize all farm land, and to add to the family food supply.

Beef cattle production has increased steadily during the last few years. This increase is due in large part to the increase in price of cattle, and in part to a definite trend toward more livestock to provide profitable utilization of non-productive cropland and to serve as another source of cash income.

During the present war emergency it appears that no other farm enterprise is more important than the production of beef cattle. This is due to the tremendous demand for meat for our armed forces, our civilian population, and our allies. The demand is such that shortages developed early in 1943, and it was found necessary to further curtail civilian domestic consumption by the use of a rationing program. This would indicate that there is a need for livestock producers to use the best practices possible in production in order to secure the greatest increase possible in meat production.

The labor requirements for the production of beef cattle are relatively small when compared to some of the other agricultural enterprises. During periods of farm labor shortage beef cattle production may be desirable in a farm business. Under farm labor shortage conditions it seems that agricultural producers must use every means possible to get the most returns from available farm labor, which means in many cases a reorganization of farm enterprises.

Prospective and present beef cattle producers may need to make a thorough study of the beef cattle enterprise in order to make a selection of the phase of business that is best suited to a given farm. This study seems to involve evaluation of information on: (1) Different phases of beef cattle business, (2) types of cattle in beef production, (3) production practices in producing cattle under the different phases of business, (4) marketing practices and (5) disease and parasite control.

The evaluation of these factors is important to the success of a beef cattle production program. A careful selection has been made of the available information from the experiment stations of the Southern states and arranged in such a manner that farmers interested in making a study of the beef cattle business may do so. It is hoped that the information presented in this publication will prove helpful to farmers in selecting and setting up a beef cattle business that is suited to individual farms.

*Jointly representing Mississippi State Vocational Board and Mississippi Agricultural Experiment Station.

PHASES OF BEEF CATTLE BUSINESS

The success of any business enterprise depends largely on the operator having a clear understanding of the business. This is as true with an agricultural undertaking as with any other kind of business. Present beef cattle producers, as well as new producers, are faced with the question of deciding on the phase of beef cattle business in which to engage. A thorough study should be made of all phases of beef cattle business or combinations of phases before deciding on the phase of business to use. A thorough study of the beef cattle business may prevent producers from failing in this enterprise.

At present, Mississippi farmers are producing cattle without making distinct divisions into given phases of business as to an age classification. Information available from experiment stations on the different phases of beef cattle business may not be directly applicable to the phases that are being used by Mississippi producers. The different phases of beef cattle business may be divided into (1) common phases and (2) the specialized phases. With a number of different businesses under each of these phases it may be necessary for producers to make certain adjustments in the information available when compared to business that is being operated on a given farm. Information is presented on the different phases of beef cattle business from experimental tests conducted in the Southern states.

The more common phases are: (1) The production of beef calves, (2) finishing beef calves, (3) the production of 2-year-old beef, (4) the production of 3-year-old beef, (5) buying mature steers and finishing on pasture, and (6) buying mature steers and finishing in feed lot.

The specialized phases are (1) the production of purebred breeding stock, and (2) the production of prime and choice beef, which will require in most cases purebred or high grade beef stock. A large percentage of the present and potential beef producers of Mississippi are not equipped to engage in the specialized phases of business.

Most of the beef producers in Mississippi are using the more common phases of business, and no doubt a large percentage of the new producers will select one or a combination of the more common phases of beef business.

To make a study of the different phases of beef business, present and prospective producers must have information dealing with the different phases of beef business. Information on the different phases of beef business is available from several Southern state experiment stations.

The experimental information available is in several publications from different experiment stations, and in some cases in such form that it would be difficult to compare the different phases of business. Several of the experimental tests have been selected and grouped according to the different phases of business. The results of the tests in each group were averaged to show what may be expected in the production of beef by using the different phases of business.

The information on the different phases of beef business is presented with the hope that it will help present and prospective beef producers to select the phase of business that is best suited to individual farms and that will give the greatest returns.

Producing Beef Calves

Calf production is necessary in the beef cattle business. Beef calves are referred to as those animals less than 1 year old and usually weighing less than 500 pounds.

Producers have the choice of producing beef calves by being either (1) fed on pasture alone during the suckling period, or (2) creep-fed on pasture during the suckling period. Considerable experimental information is available from the Southern states on the production of calves by these methods.

Tests from Mississippi, Arkansas, Louisiana, and Georgia experiment stations were selected to show what may be expected in producing beef calves by the two methods previously mentioned. The tests selected were conducted from 1 to 3 years. The calves were from purebred, grade beef, second cross, first cross, and native cows, bred to purebred beef bulls of all breeds, and native cows bred to native bulls. All of the cows with their calves were on pasture during the tests which covered the suckling period. Some of the calves were creep-fed in addition to suckling and pasture. The individual tests were averaged together regardless of the kind of calf. A summary of the average of all tests for the two methods of producing calves is shown in table 1. The individual tests included in the summary will be shown in the section of this publication dealing with the production of calves.

Table 1. Beef calf production: average of tests in Mississippi, Arkansas, Louisiana, and Georgia.

	All grades	
	Pasture alone	Creep-fed
Total number calves	226.00	83.00
Number tests	11.00	3.00
Average birth weight, lbs.	68.05	69.07
Average age at weaning, days	233.00	223.00
Average weight at weaning, lbs.	418.57	476.80
Average daily gain, lbs.	1.50	1.82
Grade	Good—	Good
Average daily feed per calf fed, lbs.		
Snapped corn	—	2.06
Peanut meal	—	.20
Rice bran	—	.62
Cottonseed meal	—	.31
Feed per 100 pounds gain: lbs.		
Snapped corn	—	113.17
Peanut meal	—	10.99
Rice bran	—	34.06
Cottonseed meal	—	17.03

Finishing Stocker Calves

A number of beef producers use this phase of beef business. They take weaned calves and usually finish to a weight ranging from 500 to 800 pounds. Careful consideration should be given to the results obtained in finishing beef calves before deciding to use this phase of business. This phase of business should no doubt be classified as semi-specialized. It requires more planning and closer supervision than some of the other phases of business.

Experimental tests are available showing the results of producing baby beef, using certain feeding practices. Tests were selected from Mississippi,

Arkansas, Louisiana, Oklahoma, and West Virginia on the production of baby beeves. These tests were conducted for a period ranging from 1 to 3 years. The calves used in these tests were from purebred, grade beef, first cross, and native cows bred to purebred bulls of all breeds, and native cows bred to native bulls. All calves were weaned and ranged in age from 6 to 9 months. In some tests the calves were fed in individual stalls while others were group fed. All calves were fed in dry lot. A summary of these tests is shown in table 2.

Table 2. Finishing beef calves for market: average of tests in Mississippi, Arkansas, Oklahoma, and West Virginia

	All grades
Number of calves	265.00
Number of tests	10.00
Initial weight, lbs.	412.00
Total weight, lbs.	739.40
Total gain, lbs.	327.40
Average daily gain, lbs.	1.86
Number days fed	176.00
Average daily ration, lbs.	
Silage*	3.45
Hay**	3.31
Cottonseed meal	2.33
Corn	7.56
Pounds feed per 100 lbs. gain, lbs.	
Silage*	186.47
Hay**	178.90
Cottonseed meal	125.91
Corn	408.54

*Corn and sorghum silage.

**Mixed hay including alfalfa, lespedeza, and prairie.

Producing 2-Year-Old Beef Steers and Cows

In some cases beef producers may have sufficient pasture to care for a large number of cattle and land available to produce cheap roughage for wintering the cattle in addition to the amount required for maintaining the breeding herd. In cases of this kind the beef producer may wish to carry steers and cows to an older age, getting the benefit of gains made on pasture and cheap roughages rather than selling the steers and calves at an early age with gains that are made with costly grain feeds.

Experimental information which begins with young calves and continues through the production of mature beef is rather limited. A test conducted by the Agricultural Experiment Station at Morgantown, West Virginia, was selected to show what a producer may expect from cattle handled by this method. The summary of this test involves three lots of cattle covering a period of 6 years. Grade Hereford cattle were used in this test. The test was started with weaned calves ranging from 7 to 9 months old. All of the cattle were handled in the same manner. During the wintering periods the cattle were fed a cheap ration with the idea of maintaining the cattle and depending mainly on gains made on pasture. At the end of two winter and summer periods the cattle were placed on feed in dry lot for 64 days. A summary is shown for the entire period, the winter periods, the summer periods, and the finishing period. The summary of this test is shown in table 3.

Table 3. Producing 2-year-old steers: West Virginia, 1925-30.

	Average of 3 lots 1925-30
Summary of entire period:	
Number of calves	22.00
Average initial weight, lbs.	479.00
Average final weight, lbs.	1,351.00
Number days total, lbs.	707.00
Average gain, lbs.	872.00
Average daily gain, lbs.	1.23
Summary of winter feeding:	
Total days winter feeding	265.00
Average daily gain winter feeding, lbs.	.795
Total gain winter feeding, lbs.	210.70
Feed per 100 pounds gain:	
Corn	25.78
Linseed meal	45.28
Cottonseed meal	154.70
Corn silage	2,398.62
Hay	506.89
Summary of pasture period:	
Total days on pasture	377.00
Total gain on pasture, lbs.	440.00
Average daily gain on pasture, lbs.	1.16
Summary of summer and winter periods:	
(2 summers and 2 winters)	
Total days summer and winter periods	642.00
Total gain summer and winter periods, lbs.	650.70
Average daily gain summer and winter periods, lbs.	1.01
Total feed required winter periods, lbs.	
Corn	54.14
Linseed meal	95.09
Cottonseed meal	324.87
Corn silage	5,037.00
Hay	1,065.00
Summary of finishing period:	
Number days finishing period	64.00
Average gain, finishing period, lbs.	219.00
Average daily gain, finishing period, lbs.	3.46
Feed per 100 pounds gain finishing period, lbs.	
Cracked corn	618.00
Cottonseed meal	57.60
Chopped green corn	58.00
Hay	178.00

Producing 3-Year-Old Steers and Cows

Some beef producers may wish to carry steers for a period longer than 2 years to allow the steers to accumulate as much weight as possible before selling. This phase of business may have possibilities where producers have a considerable amount of grazing land and land to produce cheap roughage to be used in wintering the steers.

A test illustrating this phase of business has been conducted by the Agricultural Experiment Station at Morgantown, West Virginia, and is presented here to show what a producer may expect from cattle handled by this method. The test includes two lots of cattle and was conducted for 6 years. The test was started with weaned grade Hereford calves. The calves were carried until they were 3 years old before selling. The steers were win-

tered mainly on roughage feed. They were carried through three winters and three summers. The steers did not receive any supplemental feed while on pasture. They were sold directly from the pasture at the end of the third summer period. A summary of the entire period, the winter periods, and the summer periods is shown in table 4.

Table 4. Producing 3-year-old steers: West Virginia, 1925-30.

	Average 2 lots 1925-30
Summary of entire period:	
Total number calves	16.00
Average initial weight, lbs.	476.00
Average final weight, lbs.	1,395.00
Average number days total	1,005.00
Average gain, lbs.	919.00
Average daily gain, lbs.	0.914
Total feed required: lbs.	
Corn silage	8,157.36
Mixed hay	1,069.82
Cottonseed meal	486.72
Oat straw	481.28
Summary of winter feeding: (3 winters)	
Total days winter feeding	396.00
Total gain winter feeding, bs.	161.00
Average gain winter feeding, lbs.	0.40
Feed per 100 lbs. gain, lbs.	
Corn silage	5,200.00
Mixed hay	647.90
Oat straw	312.50
Cottonseed meal	302.50
Summary of pasture period: (3 summers)	
Total days on pasture	609.00
Total gain on pasture, lbs.	656.00
Average daily gain, lbs.	1.24

Finishing Mature Steers in Dry Lot with Grain Feeds

This phase of business is used by some beef producers in Mississippi, and can be practiced with either home-grown or purchased stock. A careful comparison of this phase of business with other phases should be made before selecting the one to use.

Several experimental tests are available on finishing mature steers with feed in dry lot. Tests were selected from Mississippi, Georgia, Louisiana, and Indiana to show what a producer may expect from this type of beef cattle business. The tests were conducted for a period ranging from 1 to 3 years. The steers used were grade beef steers approximately 2 years of age. All cattle were group-fed in dry lot beginning in November and were sold about April 1. An average of the individual tests is shown in table 5.

Table 5. Finishing mature steers on feed: average of information in four states.

	Average of 5 tests 18 lots
Total number steers	291.00
Average number days on feed	137.00
Average initial weight, lbs.	653.00
Average final weight, lbs.	925.00
Average gain, lbs.	272.00
Average daily gain, lbs.	1.99
Average daily ration: lbs.	
Corn	12.13
Cottonseed meal	2.29
Silage	5.75
Hay	2.18
Oat straw	.34
Cottonseed hulls	2.00
Feed per 100 pounds gain: lbs.	
Corn	772.78
Cottonseed meal	114.63
Silage	287.84
Hay	109.13
Oat straw	17.00
Cottonseed hulls	100.00

Finishing Mature Steers with Grain on Grass Compared with Grass Alone

This phase of business may be used with either home-grown or purchased stock. Experiments have been conducted showing the results that may be expected from cattle finished with grain on pasture as compared with pasture alone. This practice has been broken down into two parts, (1) cattle sold in July and (2) cattle sold in the fall of the year. A combination of these methods may be advisable where a producer has an abundance of grass during the spring and early summer months, and the pasture is not so plentiful during late summer and fall. A combination of the methods will provide full utilization of available grass.

Experiments were selected from Mississippi, Louisiana, and Alabama to show what may be expected from beef cattle produced in this manner.

These tests were conducted for periods ranging from 1 to 3 years. The cattle used were native, first cross, and high grade steers, and were approximately 2 years old at the beginning of the test. The experimental tests were summarized and averaged. The results of the summary are shown in table 6.

Table 6. Finishing steers on pasture with and without supplemental feed: average of tests in Mississippi, Louisiana, and Alabama.

	Marketed in July		Marketed in fall	
	Pasture plus supplemental feed	Pasture alone	Pasture plus supplemental feed	Pasture alone
Number of tests	5.00	5.00	2.00	5.00
Number of steers	128.00	92.00	73.00	105.00
Days on pasture	103.00	100.00	152.00	163.00
Average initial weight, lbs.	577.00	595.00	596.00	595.00
Average total weight, lbs.	804.00	772.00	870.00	846.00
Average total gain, lbs.	227.00	177.00	274.00	251.00
Average daily gain, lbs.	2.00	1.77	1.80	1.53
Average daily ration: lbs.				
Cottonseed meal	3.74	—	3.35	—
Brewer's rice	.31	—	.43	—
Corn	.61	—	—	—
Hay	—	—	.14	—
Feed per 100 pounds gain: lbs.				
Cottonseed meal	170.00	—	186.09	—
Brewer's rice	17.27	—	23.09	—
Corn	27.72	—	—	—
Hay	—	—	7.71	—

Comparing Different Phases of Beef Cattle Business

In selecting the phase of beef cattle business in which to engage it seems important that farmers thoroughly consider the different phases of business. There are a number of factors that should be considered in making a comparison of the different phases of business. Some of these factors are (1) returns, (2) productive capacity of farm in both grain and hay, (3) availability of pasture, (4) prospects for utilizing pasture and field grazing, (5) prospects for purchasing cattle in local area, and (6) comparison of prices of cattle during different seasons of the year to be used in determining the best time of the year to purchase cattle.

It seems important that all these factors be considered in making a selection of a phase of beef cattle business. A suggested form for determining returns from the different phases of business is given in table 7. It is suggested that comparisons of other factors be made on a similar basis and that this should prove very helpful in selecting the phase of beef cattle business best suited to an individual farm.

Table 7.—Suggested form for calculating costs and returns from different phases of beef cattle business*

Type of business	Initial weight	Final weight	Cost of feed	Cost of animal	Total cost	Total value	Returns above cost

*It is suggested that this form be filled in, using the figures available on the different phases of the beef cattle business found in tables 1 to 6 above.

TYPES OF CATTLE IN BEEF PRODUCTION

There are a number of different types and breeds of cattle used in beef production. Different types or breeds are best suited under different conditions. The beef producer is faced with the question of deciding on the type of cattle to be used in a beef cattle business. Producers must first decide on the phase of beef cattle business in which he is to be engaged. When the phase of business has been decided on, the type or breed of cattle best suited to that phase should be selected. In order to select the type or breed of cattle best suited to a given phase of beef business it is necessary to consider information on the different breeds of cattle available and a comparison of the different breeds for actual beef production.

Comparison of Types of Cattle in Beef Production

Under present conditions a very small percentage of purebred cattle produced in Mississippi are used for beef. They are used largely for breeding purposes. The beef produced comes largely from grade beef breeds, first and second crosses, and from native cattle. Some experiments have been conducted that will indicate a trend of what may be expected from the different types of cattle in beef production. A thorough study should be made of the different types of cattle under the different phases of business before selecting a type of cattle to use. A number of experimental tests have been selected from the Southern states to give a comparison of the different types of cattle in producing (1) beef calves, (2) finished calves, and (3) mature beef cattle. The individual tests were averaged and a summary is presented under each phase of business.



Figure 1. Purebred bulls used in breeding native south Mississippi cows to produce calves shown in figures 3, 4, 5, and 6.



Figure 2. Native south Mississippi cows used in producing first-cross calves shown in figures 3, 4, 5, and 6.



Figure 3. Calves produced from native south Mississippi cows bred to purebred Short-horn bull.

Comparison of Different Types of Cattle in Producing Beef Calves

A beef producer has the choice of using purebred, grade, second cross, first cross, or native cattle in producing beef calves. A producer also has

the choice of producing the calves on pasture alone during the suckling period or creep-feeding the calves on pasture during the suckling period.

Experimental tests were selected from Mississippi, Arkansas, Louisiana, and Georgia experiment stations to show a comparison of the different types



Figure 4. Calves produced from native south Mississippi cows bred to purebred Hereford bull.



Figure 5. Calves produced from native south Mississippi cows bred to purebred Angus bull.

of calves for beef. All of the cows in these tests with their calves were on pasture during the suckling period. A summary of the results of these tests is given in table 8. Figures 3, 4, 5, 6, 7, and 8 illustrate beef calves produced from different types of cattle.



Figure 6. Calves produced from native south Mississippi cows bred to purebred Devon bull.



Figure 7. Calves produced from native south Mississippi cows bred to native south Mississippi bull.



Figure 8. Calves produced from high grade beef cows bred to high grade beef bulls.

Table 8. Beef calf production data: average of several tests.

	Purebreds	Grades	Second cross	First cross	Natives
Not creep-fed					
Total number calves	21	74	23	76	32
Number tests	1	4	1	3	2
Average birth weight, lbs.	66.9	71.6	65.7	67.6	63.4
Av. age at weaning, days	226.0	238.0	223.0	202.0	210.0
Av. weight at weaning, lbs.	426.2	414.1	440.3	410.0	428.7
Av. daily gain, lbs.	1.59	1.44	1.68	1.7	1.75
Grade	Good	Good	Good	Good	Medium
Creep-fed					
Total number calves	25	39		19	
Number tests	1	1		1	
Average birth weight, lbs.	70.81	69.1		70.42	
Av. age at weaning, days	220.00	229.0		215.00	
Av. weight at weaning, lbs.	482.28	481.0		461.31	
Av. daily gain, lbs.	1.83	1.8		1.82	
Av. days creep-fed	156.00	111.0		142.00	
Grade	Good	Good		Good	
Av. daily feed: lbs.					
Snapped corn	3.24	1.32		2.01	
Peanut meal	.46	—		.29	
Rice bran	—	1.32		—	
Cottonseed meal	—	.66		—	
Feed per 100 lbs. gain: lbs.					
Snapped corn	124.0	146.50		72.99	
Peanut meal	18.0	—		10.42	
Rice bran	—	146.50		10.42	
Cottonseed meal	—	73.20		—	

Different Types of Cattle for Finished Calf Production

A number of beef producers specialize in finishing beef calves. The calves are taken at weaning time and finished on grain feeds to a weight ranging from 500 to 800 pounds.

Mississippi, Arkansas, Louisiana, Oklahoma, and West Virginia agricultural experiment stations have conducted a number of tests involving the different types or breeds of calves for finishing on grain feeds. A number of these tests were selected and the results of the individual tests averaged. A summary of the average for the different types or breeds is shown in table 9. Some of the calves in these tests were fed in individual stalls while others were creep-fed. All calves were fed in dry lot.

Table 9. Finishing beef calves for market on grain feed: average results.

	Purebreds	Grades	Second cross	First cross	Natives
Number of calves	21.00	126.00	23.00	63.00	32.00
Number tests	1.00	4.00	1.00	2.00	2.00
Initial weight, lbs.	426.00	399.50	440.30	413.70	428.00
Total weight, lbs.	705.10	789.20	705.60	695.90	659.70
Total gain, lbs.	278.10	389.70	265.30	282.20	231.00
Average daily gain, lbs.	1.77	2.06	1.69	1.66	1.40
Number days fed	157.00	188.40	157.00	170.00	164.00
Average daily ration: lbs.					
Silage	2.40	2.82	3.30	4.67	3.71
Alfalfa hay	5.10	2.95*	5.00	2.66	3.61**
Cottonseed meal	2.10	2.64	2.00	2.09	1.97
Corn	8.30	7.22	8.20	7.92	7.24
Cottonseed hulls	—	.34	—	—	—
Oystershell flour	—	.10	—	—	—
Feed per 100 lbs. gain: lbs.					
Silage	192.10	136.88	195.00	281.13	264.96
Alfalfa hay	288.15	143.19*	295.00	160.13	257.82**
Cottonseed meal	118.65	128.15	118.20	125.82	140.69
Corn	468.95	350.50	494.62	476.78	517.08
Cottonseed hulls	—	16.50	—	—	—
Oystershell flour	—	4.85	—	—	—

*Mixed hay including alfalfa, prairie, and lespedeza.

**Alfalfa and lespedeza hay.

Mature Steers for Beef Production

In the production of mature beef cattle, consideration should be given to the type cattle to use. The market grade of cattle at the time of selling will have a direct bearing on the sale price. Native and first cross cattle when carried to the mature beef stage often have a tendency to revert toward the undesirable characteristics of the parent stock. The average daily gain made by the native and first cross cattle may average as high as some of the higher grades and finish to a weight equal to the higher grades, but the market grade may be so low that there will be considerable difference between the market values.

Some experimental tests have been conducted comparing the different types of cattle in the production of mature beef. Tests were selected from Mississippi, Alabama, and Louisiana. The cattle used in these tests were high grade, first cross, and native steers. The tests were conducted on pasture supplemented with feed and on pasture alone. The steers averaged ap-

proximately 2 years of age at the beginning of the tests. The results of tests selected were averaged, and the summary is shown in table 10.

Table 10. Types of cattle in producing mature beef cattle: average of results in Mississippi, Alabama, and Louisiana.

	Pasture plus supplement			Pasture alone		
	Grades	First cross	Natives	Grades	First cross	Natives
Number of steers	100.0	20.0	24.0	155.0	10.0	12.0
Number tests	4.0	1.0	1.0	5.0	1.0	1.0
Initial weight, lbs.	612.0	702.0	511.0	625.0	701.0	501.0
Total weight, lbs.	840.0	922.0	728.0	825.0	906.0	707.0
Total gains, lbs.	228.0	220.0	216.0	200.0	207.0	286.0
Average daily gain, lbs.	1.94	1.82	1.91	1.57	1.71	1.72
Total number days	115.0	121.0	113.0	127.0	121.0	166.0
Average daily ration: lbs.						
Cottonseed meal	3.76	3.75	3.75	—	—	—
Brewer's rice	.48	—	—	—	—	—
Corn	.75	—	—	—	—	—
Feed per 100 lbs. gain: lbs.						
Cottonseed meal	164.7	206.0	196.0	—	—	—
Brewer's rice	21.1	—	—	—	—	—
Corn	33.0	—	—	—	—	—

Comparison of Market Grades of Cattle in Beef Production

Many beef producers finish different market grades of cattle. The market grade at the time of marketing has a direct bearing on the price producers receive for the cattle. Experiments have been conducted by the Pennsylvania and North Carolina agricultural experiment stations comparing the different market grades of cattle. These tests are given to indicate the results producers may expect when finishing different market grades of cattle.

Fattening Good, Medium, and Common Grade Steers

Conducted by: Pennsylvania Agricultural Experiment Station.

Conducted at: State College, Pennsylvania.

Period: 1931-1935.

Purpose: To determine what grade of feeder steers make the most profitable cattle.

Procedure and conditions: The cattle used in this series of tests were purchased as follows:

First trial—Lancaster, Pennsylvania, December 21, 1931.

Second trial—Lancaster, Pennsylvania, December 18, 1932.

Third trial—Chicago, Illinois, December 13, 1933.

Fourth trial—Chicago, Illinois, November 20, 1934.

All steers were tuberculin-tested and those in the third and fourth trials were vaccinated against hemorrhagic septicemia.

The trials were conducted at the College feed lots and for a period of 168 days each. The fattening pens were the open shed type, 30 by 30 feet under roof with clay floor and 30 by 18 feet in the open with a concrete

floor. The mangers extended the full length of the feeding shed, allowing 30 feet of manger space per lot, with 12 steers in each lot. Concrete water troughs were in the open end of each lot.

The three grades of cattle received exactly the same combination of feeds, hand fed according to appetite. It consisted of corn and cob meal, cottonseed meal (41 percent), corn silage, and mixed hay. The corn and cob meal was hammer mill ground, using $\frac{1}{2}$ -inch screen, and was a good grade of locally grown corn, running approximately 14 percent moisture. In the first two trials (1931-32 and 1932-33), choice cottonseed meal and linseed meal were mixed in equal parts and fed at the rate of $2\frac{1}{2}$ pounds per hundred pounds liveweight. In 1933-34, choice cottonseed meal was fed as the sole protein concentrate at the same rate per hundred pounds liveweight. Pea-size cottonseed was fed in 1933-34 at the same rate.

The silage was an excellent grade of mature corn silage, while the mixed hay was very mediocre in quality.

All lots were fed grain and silage twice a day, 6:30 a. m., and 4:30 p. m., with hay once a day, about 10:00 a. m. Salt and water were before the cattle at all times.

Table 11 Comparison of good, medium, and common steers: Pennsylvania, 1931-35.

	Good steers	Medium steers	Common steers
Average initial weight, lbs.	705.00	694.00	698.00
Average final weight, lbs.	1111.00	1121.00	1126.00
Average daily gain per steer, lbs.	2.40	2.53	2.54
Average daily rations: lbs.			
Corn silage	14.60	15.11	15.16
Corn and cob meal	14.09	14.26	14.24
Cottonseed meal	2.05	2.05	2.05
Mixed hay	1.49	1.52	1.51

Reference: Pennsylvania Agricultural Experiment Station Bulletin 329, "Fattening Good, Medium, and Common Grade Steers," pages 3, 4, and 5, table 5, State College, Pennsylvania, May 1936.

Native versus Grade Yearling Cattle for Beef

Conducted by: North Carolina Agricultural Experiment Station.

Conducted at: Raleigh, North Carolina.

Period: Four years, 1930-31 through 1933-34.

Purpose: To compare the offspring produced from native cows and bull with the offspring produced from native cows and a purebred Hereford bull, by making studies of the live animals during the growth and fattening period.

Procedure and conditions: The cows used in these trials were purchased in Onslow County and were typical of the native "scrub" cattle in the tide-water area of North Carolina. Many of the mature animals weighed less than 600 pounds and were distinctly lacking in beef type. The native bull was a typical scrub and deficient in beef conformation.

Two purebred Hereford bulls were used during the progress of the experiment, one being purchased in the eastern and the other in the north-western part of this State. Both were of good beef type and conformation.

The cattle were grazed on native reeds from May 1 to January 1 and

were then turned into cornstalk fields until about March 1. Harvested feeds and rye pasture were used to maintain the herd during March and April.

The calves were dropped during February, March, and April, and weaned about December 1. They were wintered on corn field gleanings, cottonseed meal, soybean hay, and corn shucks, then grazed principally on reeds during the second summer, being taken off pasture about November 15 and put in fattening pens.

During the breeding season (May 1 to August 1) the cows were divided into two groups as uniform as possible with respect to size, form, quality, thrift, age, and condition.

Locally grown white corn, Highland Horse Tooth variety, with a commercial grade of No. 3 was used. The soybean hay (Mammoth Yellow or Tokyo) was grown at the Blackland Station. It was cut when the beans were approximately one-half mature, stacked on frames in the field, and stored in the barns after being thoroughly cured. The cottonseed meal was guaranteed to contain 36 percent protein.

Salt and fresh water were kept before the animals at all times.

Table 12. Average comparison of native versus grade Hereford yearlings, North Carolina.

	Native cattle	Grade cattle
Total number in lot	48 26 steers 22 heifers	46 20 steers 26 heifers
Average number days on test	144.25	144.25
Average age at beginning of test, days	586.00	569.00
Average weight at beginning of test, lbs.	544.51	587.41
Average weight per day of age at beginning of test, lbs.	.93	1.03
Average feeder cattle grade	Low medium	High medium
Average weight at end of test, lbs.	789.62	894.72
Average weight per day of age at end of test, lbs.	1.08	1.25
Average slaughter grade	Low medium	Low good
Average gain during test, lbs.	245.11	307.31
Average daily gain during test, lbs.	1.70	2.13
Average liveweight at slaughter, lbs.	747.58	840.70
Average shrink, lbs.	42.04	54.02
Percent shrink	5.35	6.10
Average feed consumed per day:		
Shelled corn, lbs.	10.99	12.33
Cottonseed meal, lbs.	1.50	1.50
Soybean hay, lbs.	9.19	9.78
Average feed required per 100 lbs. gain:		
Shelled corn, lbs.	646.45	576.97
Cottonseed meal, lbs.	82.18	67.65
Soybean hay, lbs.	550.47	460.03

Reference: North Carolina Agricultural Experiment Station Bulletin 307, "Production and Quality of Meat from Native and Grade Yearling Cattle," pages 3, 4, 5, and 6, table 7, Raleigh, North Carolina, November 1936.

THE PRODUCTION OF BEEF CALVES

The production of beef cattle in Mississippi has made a definite increase during the last few years. The production of beef calves has been a substantial part of the increase. There seems to be little doubt that producers and prospective producers will continue to increase the production of beef calves.

Producers selecting the production of beef calves as a phase of the beef business in which to engage may wish information on the production of calves. The success in producing calves depends largely on the selection and management of the breeding herd.

Breeding Herd Management and Calf Production Data

The management of breeding stock is of extreme importance in the production of beef calves.

In 1937 the Mississippi Experiment Station started a series of projects in the production of beef calves, using south Mississippi native cows and purebred beef bulls. At the Natchez Branch Experiment Station, 50 mature cows and 2 purebred bulls were purchased in 1940. In 1941 additional trials were started in the management of breeding stock and the production of calves at the Central Station, the Oktibbeha-Winston Land Use Area, and at the Holly Spring Branch Experiment Station. These trials are not set up on a uniform basis; therefore, direct comparisons are not possible.

A small calf crop was produced during the year the cattle were purchased in all cases except one. The cows for the tests beginning in 1941 which were located at the Central Station, Oktibbeha-Winston Land Use Research Area, Holly Springs, and Natchez were purchased at random in south Mississippi. The 170 cows purchased for these four tests produced only 45 calves in 1941, or 26 percent. In 1942, the 149 cows that remained in these tests were bred to registered bulls under a controlled breeding system, and 110 calves were produced, or 73.8 percent calf crop. In 1942, 180 additional cows were purchased. These cows were carefully selected as to vigor and likelihood of being bred. Shortly after arriving at State College, 16 of the cows died. The remaining 164 cows produced 124 calves, or 75.6 percent calf crop. All of the calves produced the first year in these trials were from native south Mississippi bulls. When breeding stock is purchased they should be carefully selected or the producer may get a very small calf crop the first year as indicated by the results of the trials mentioned above. The south Mississippi cows were bred on the range; therefore, there was no uniformity following the first breeding of cows after purchase.

The native south Mississippi cows used by the Station are larger than the Jersey-mixed type found in central and north Mississippi and produce calves that grow well and sell well. They are range-grown, however, and usually in poor flesh in winter and early spring. Selection, purchase, and shipment of these animals in the fall of the year should serve to obviate or correct the difficulties experienced in losses by death and low-percent calf crops following the first breeding of cows after purchase.

Beef Calf Production from Native South Mississippi Cows and Beef Bulls, Mississippi Agricultural Experiment Station

The pasture on which the cattle in this trial were placed had been de-

veloped during the past three-quarters of a century. The pasture is located in the northeast prairie area.

In February 1941, 23 head of native south Mississippi cows were purchased for the State College trial. Three of these cows died shortly after arrival. In 1941 only 5 calves were produced from the 20 cows, these calves being sired by native bulls. The cattle in the State College trial were confined to pasture without shelter in summer or winter. Winter feed has consisted of hay cut from and stacked on the pasture. No other feed has been fed.

During 1941, two of the cows were sold as a result of positive reaction to Bang's disease, leaving a total of 18 cows for the 1942 breeding season. The 18 cows were bred to a registered Hereford bull. The cows were bred by allowing the bull to range with the cows during June, July, and August 1941. The 18 cows produced a total of 15 calves in 1942. A summary of the 1941-42 results is given in table 13.

Table 13. Beef calf production, State College, Mississippi, 1941-42.

	1941	1942
Total number cows	23	18
Number cows died	3	0
Number calves produced	5	15
Average weight of calves at weaning	—	435

Reference: Mississippi Agricultural Experiment Station Bulletin 371, "Beef Calf Production in Mississippi," pages 6 and 7, November 1942, State College, Mississippi.

Beef Calf Production at Holly Springs Branch Station

In March 1941, 30 native south Mississippi or "scrub" cows were purchased by the Animal Husbandry Department of the Mississippi Experiment Station for the Holly Springs Branch Station. Two cows already owned by the branch station were added to the herd. Two of the cows died shortly after their arrival at Holly Springs; a third cow was disposed of due to a dislocated hip.

These cows were placed on a 90- to 100-acre pasture. The soil might be classified as a light phase of brown loam. All of the pasture tract was treated with superphosphate in 1937 and has since been mowed or clipped as needed, usually twice a year. The pasture forage consists mainly of common lespedeza, bermuda grass, and hop clover, with some dallis grass and sweet clover.

Eight calves sired by native bulls were produced during 1941.

The cows were wintered during the 1941-42 period on a 30-acre pasture, largely on pasture clippings which have been cut and handled as hay and stacked on the pasture. Beginning in December and continuing until April 7, the cows were fed an additional 600 pounds of roughage, fed daily. During the last 30 days the cows were fed an additional 100 pounds of low quality corn in the husk by simply scattering it on the ground.

The 29 cows remaining were bred to a registered Aberdeen-Angus bull

during June, July, and August of 1941; they produced 28 calves, 5 of these being late calves. A summary of the results of this trial are shown in table 14.

Table 14. Beef calf production, Holly Springs, 1941-42.

	1941	1942
Total number cows	32	29
Number cows died	2	0
Average weight of cows, Mar. 1, 1941, lbs.	403	—
Average weight of cows, Sept. 1, 1941, lbs.	711	—
Average weight of cows, Sept. 1, 1942, lbs.	—	792
Number calves produced	8	28
Average weight of calves at weaning, lbs.	—	378
Number calves sold	8	23
Average weight of calves sold, lbs.	—	428

Reference: Mississippi Experiment Station Bulletin 371, "Beef Calf Production in Mississippi," pages 8, 9, 10, and 11, November 1942, State College, Mississippi.

Beef Calf Production at the Natchez Branch Station

The beef calf production trials were started at the Natchez Branch Experiment Station in 1940. Twenty-five native south Mississippi cows were purchased in January 1940 and 25 additional cows were purchased in September 1940. Three of the 50 cows purchased died and 1 cow was sold. One heifer produced from the first lot of cattle has been added to the herd giving a total of 47 cows in the herd in 1942.

The cattle were placed on a pasture containing approximately 240 acres. The pastures are rough and hilly, being considered a deep phase brown loam soil. The pasture land has been cleared of trees, brush and briars, terraced, seeded, and mowed.

All the pasture area was fertilized with phosphate at the rate of 40 pounds phosphoric acid per acre, the source being basic slag at the rate of 500 pounds per acre on some portions, and TVA phosphate on other portions. The pasture was seeded with dallis grass and white dutch clover in 1940. A sufficient stand of volunteer lespedeza was already available. The pastures have been mowed or clipped twice each year since 1940. The cattle have been confined to the pasture area since arrival at the Station; no barn or other cover is provided. The standard State College wintering ration was fed at Natchez during the winter months, which consisted of the following ingredients per 1000 pounds liveweight: 30 pounds sorghum silage, 5 pounds grass hay, 1 pound cottonseed meal.

The 47 native cows produced 21 calves in 1941 and 26 calves in 1942. These cows were bred to registered Hereford bulls. A summary of the results of this trial is given in table 15.

Table 15. Beef calf production. Natchez, 1941-42.

	1941	1942
Total number cows	50	47
Number cows died	3	—
Total number calves produced	21	26
Average weight of calves at weaning, lbs.	292	360

Reference: Mississippi Agricultural Experiment Station Bulletin 371, "Beef Calf Production in Mississippi," pages 11, 12, 13, 14, and 15, November 1942, State College, Mississippi.

Beef Calf Production on Oktibbeha-Winston Land Use Research Area, 2 Years, 1941 and 1942

The beef calf production trials on the Oktibbeha-Winston Land Use Research Area are located in a 90,000 acre tract of submarginal land purchased by the Federal Government in several of the east central Mississippi counties. Approximately 4,000 acres of this tract have been leased to the Mississippi Agricultural Experiment Station through the Soil Conservation Service for land use investigations.

The upland soils included in this tract are mostly Lufkin, a soil characteristic of the flatwoods area. The soils in the flatwoods area are generally considered as relatively unproductive. In an effort to determine whether these soils could be profitably utilized as pasture land, the Mississippi Experiment Station started a series of grazing experiments in the spring of 1941.

In this trial, 3 pastures including 80 acres each were fenced separately. It was necessary to remove considerable growth of small trees, brush and briars, and undesirable plants from this area. All the pastures have been mowed or clipped twice each year since the beginning of the trial. No other preparation and no seedings have been made on these pastures.

In February 1941, 67 native south Mississippi cows were purchased for this area. Seven of these cows died shortly after they arrived at State College. The remaining 60 cows were divided into 3 lots and were placed on the 3 pastures. Each of these lots was headed by a registered Hereford bull. The cattle were wintered on these pastures in 1941 and 1942. No shelter was available except the wooded areas in the pastures. The cattle were wintered on pasture clippings stacked in the pastures, which consisted mainly of broom sedge but which maintained the cattle until March 1, 1942. At that time the cattle were fed a better quality of hay. In 1941, the 60 cows produced 11 calves. These calves were sired by native bulls. Three cows died during the 1941-42 winter period, one cow died in the summer of 1942, and one cow was sold in February 1941. The cows were bred to registered Hereford bulls in June, July, and August 1941, and the 56 cows produced 41 calves in 1942. A summary of the results of this test is shown in table 16.

Table 16. Beef calf production, Oktibbeha-Winston Land Use Area, 1941-42.

	1941	1942
Total number cows	67	56
Number cows died	11	—
Total number calves produced	11	41
Average weight of calves at weaning, lbs.	—	380

Reference: Mississippi Agricultural Experiment Station Bulletin 371, "Beef Calf Production in Mississippi," page 17, table 5, November 1942, State College, Mississippi.

Beef Calf Production on the Oktibbeha-Winston Land Use Research Area, 1 Year, 1942

During the winter of 1941-42 it was decided to increase the livestock grazing phase of the land utilization research work in the area, so additional pasture land was cleared and prepared for grazing. Approximately 400 acres of land were brushed and prepared for mowing, this being the only improvement made on pasture land for this trial. The pasture was mowed twice during the 1942 grazing season.

To stock this area, 181 cows plus 25 calves were purchased in south Mississippi during February and March 1942. The cows were carefully selected before they were bought. Seven of the cows died in transit. Nine additional cows died soon after they arrived at State College. The cows purchased had been range bred to native south Mississippi bulls. The remaining 164 cows produced 124 calves in 1942. This is a much higher percentage of calves than has been obtained in any of the previous trials started. The high percentage calf crop may be explained partly by the selection process when the cattle were bought.

Since the cows had been range bred, there was great variation in the ages of calves when sold at the end of the 1942 grazing season. The fact that many of the calves were young accounts, in main or part, for the low average weight. It is believed that 1942 results from the other group of pastures in the area are more representative of gains made by calves on the type of pasture.

The results of the 1942 area trial are shown in table 17.

Table 17. Beef calf production, Oktibbeha-Winston Land Use Area, 1942.

	1942
Total number cows	180
Number cows died	16
Number cows remaining	164
Total number calves produced	124
Average weight of calves when sold, lbs.	255.5

Reference: Mississippi Agricultural Experiment Station Bulletin 371, "Beef Calf Production in Mississippi," page 21, table 6, November 1942, State College, Mississippi.

Calf Production and Management of Purebred and Grade Aberdeen-Angus and Native Cattle

Conducted by: Arkansas Agricultural Experiment Station.

Conducted at: Fayetteville, Arkansas.

Period: 1925-1927.

Purpose: To compare purebred Aberdeen-Angus calves, first- and second-cross Aberdeen-Angus calves, and Arkansas native calves as a source of beef.

Procedure and conditions: Four lots of 10 cows each were used, the breeding of the cows being as follows:

Lot 1, Purebred Aberdeen-Angus.

Lot 2, Grade Aberdeen-Angus, the sire being purebred Aberdeen-Angus and dams being nondescript breed, common to eastern Arkansas.

Lot 3, Arkansas native.

Lot 4, Arkansas native.

Lots 1, 2, and 3 were bred to a purebred Aberdeen-Angus bull, while lot 4 was bred to an Arkansas native bull.

The 10 purebred cows and 1 purebred bull were taken from the herd, the 10 grade cows were purchased in northeast Arkansas, and the 20 scrub cows and 1 bull were obtained in southeast Arkansas. In selecting these cattle every reasonable effort was made to have them as nearly representative as possible of the class to which they belong.

The four lots of cows were treated as nearly alike as possible throughout the experiment. Two pastures were used. Lots 1, 2, and 3, bred to the purebred bull, were kept on one pasture; lot 4 bred to the native bull was kept on the other pasture. The two groups were changed every 2 weeks after the beginning of the grazing season.

The results with the cows during this test are shown in table 18.

Table 18. Data on cows, summer and winter: Arkansas 1925-27.

	Aberdeen-Angus		First cross grades		Natives		Natives	
	3 Sum-mers	3 Win-ters	4 Sum-mers	3 Win-ters	4 Sum-mers	3 Win-ters	4 Sum-mers	3 Win-ters
Number cows	36	30	38	30	37	28	40	30
Initial weight, lbs.	982	966	820	835	685	724	668	720
Final weight, lbs.	978	1022	853	866	745	780	744	747
Gain or loss, lbs.	—4	56	33	31	60	56	76	27
Total number calves	21		23		23		21	
Av. ration per 1000 lbs. liveweight.								
Silage, lbs.	32.73		33.12		31.77		32.83	
Cottonseed meal, lbs.	2.06		2.13		2.01		2.15	
Rice straw, lbs.	4.22*		4.21*		4.01*		4.09*	
Rice bran, lbs.	1.54		1.62		1.58		1.59	

*Includes oat hay.

Reference: Arkansas Agricultural Experiment Station Bulletin 247, "Beef Producing Qualities of Purebred Aberdeen-Angus Cattle Compared with Arkansas Native Cattle," pages 3, 4, and 6, tables 1, 4, and 5, Fayetteville, Arkansas, March 1931.

Wintering Purebred Polled Hereford, Grade Hereford, and Native and Grade Jersey Cows

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: Winter 1939-40.

Purpose: To compare wintering of different grades of breeding beef cows.

Procedure and conditions: Three herds of purebred polled Hereford, grade Hereford and native cows were wintered in 1939-40 on stalk fields from the first of November to the last of January and the first of February. The fields had been planted to corn and velvet beans in the proportion of two rows of corn to one row of velvet beans. The corn was harvested before the cows were turned into the field. After the cows were removed from the stalk fields

they were fed a ration of sorghum silage, cottonseed meal, and oat straw. All cows had a mineral mixture before them at all times.

Table 19 shows the results of the early and late wintering test with the three herds.

Table 19. Wintering breeding cows in Georgia: Winter, 1939-40.

	Purebred Polled Herefords	Grade Herefords	Native and grade Jerseys
Early winter, 1939-40			
Size of field, acres	103	90	81
Average number of cattle grazed	38	48	39
Date on test	Nov. 10	Nov. 17	Nov. 6
Date off test	Jan. 27	Feb. 6	Jan. 31
Average initial weight, lbs.	1037	875	857
Average final weight, lbs.	992	865	818
Average loss per animal, lbs.	45	10	39
Average daily loss per animal, lbs.	.58	.132	.472
Late winter, 1939-40			
Date on test	Jan. 27	Feb. 6	Jan. 31
Date off test	Mar. 28	Mar. 28	Mar. 28
Number cows fed	38	47	38
Average initial weight, lbs.	992	870	819
Average final weight, lbs.	936	793	748
Average loss per animal, lbs.	56	77	71
Average daily feed:			
Sorghum silage, lbs.	34.12	33.79	34.85
Cottonseed meal, lbs.	2.91	2.36	3.01
Oat straw, lbs.	4.94	3.95	5.09
Number of calves dropped by cows	29*	34**	32
Total initial weight of calves, lbs.	2080	2440	2205
Total final weight of calves, lbs.	2929	3302	3657

*One calf stillborn, weight not determined.

**Two calves stillborn.

Reference: Georgia Coastal Plain Experiment Station Twentieth Report, 1939-1940, pages 52, 53, and 54, tables 34 and 35, Tifton, Georgia, July 1940.

Breeds of Polled Beef Cattle in Beef Calf Production

Conducted by: Main Station, Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1937-1940.

Purpose: To compare native calves with calves produced from native cows bred to registered Polled Devon, Polled Shorthorn, Polled Hereford, and Aberdeen-Angus bulls.

Procedure and conditions: This experiment was set up to compare the performance of calves produced in Mississippi from six different types of parentage as to their efficiency for producing beef during a suckling period. Five lots of calves out of native Mississippi cows and sired by Native, Polled Devon, Polled Shorthorn, Polled Hereford, and Aberdeen-Angus bulls, respectively, as well as a mixed lot of high grade Hereford and Angus calves, were used.

The cows used for producing the first five lots of calves were purchased by the Experiment Station in the late summer of 1936. They were selected from native cattle herds of Pearl River and Lamar Counties in south Missis-

ssippi. No improved breeding had ever been introduced into these herds to the knowledge of their previous owners. These cows were of red, white, and black colors, with solid, spotted, and brindled variations.

These cows were divided into five uniform groups at the beginning of the experiment and each group was bred to its respective bull at the start of each test. All the bulls used for siring these first five lots of calves were of superior beef type and breeding with the exception of the native bull. This animal was of nondescript breeding, having also come from a native cattle herd of south Mississippi.

After the cows were brought to the Mississippi Experiment Station they were handled on a permanent pasture throughout the year. During the winter they had free access to grass hay (pasture clippings) that was cut and stacked on the pasture during the previous pasture season. No other feeds were fed.

During the spring of 1938, 57 calves were produced by these cows. They were calved largely during the month of May and were pastured with their dams until November 30. The calves were weaned, graded as feeder calves, and placed on experimental feeds in dry lot.

Table 20. Breeds of polled beef cattle in beef cattle production: Mississippi, 1937-1940.

	Lot 1 Native Check lot	Lot 2 Polled Devon	Lot 3 Polled Shorthorn	Lot 4 Polled Hereford	Lot 5 Aberdeen Angus	Av. of lots 2 to 5	Lot 1A high grades
Suckling Period—1928 and 1939							
Number of calves	11	11	11	17	10	43	10
Av. birth wt., lbs.	62	74	66	67	64	68	72
Av. wt. at weaning, lbs.	426	418	424	412	375	408	438
Av. gain, birth to weaning, lbs.	364	344	358	346	311	340	366
Av. age at weaning, days	196	191	198	206	190	196	206
Av. daily gain, birth to weaning, lbs.	1.86	1.80	1.80	1.67	1.64	1.74	1.77
Av. grade as feeder cattle	Medium	Good	Good	Good	Good	Good	Choice

References: Mississippi Farm Research, September 1939.

Mississippi Agricultural Experiment Station Bulletin 347, "The Influence of Breeding on the Performance of Beef Calves Produced in Mississippi," pages 3, 6, 9, and 12, tables 1 and 4, State College, Mississippi, August 1940.

Beef Producing Qualities of Purebred Aberdeen-Angus Calves Compared with Arkansas Native Cattle

Conducted by: Arkansas Agricultural Experiment Station.

Conducted at: Fayetteville, Arkansas.

Period: 1925-27.

Purpose: To compare purebred Aberdeen-Angus calves, first- and second-cross Aberdeen-Angus calves, and Arkansas native calves as sources of beef.

Procedure and conditions: The calves used in this test were from cows bred as follows:

Lot 1, Purebred Aberdeen-Angus.

Lot 2, Grade Aberdeen-Angus, the sire being purebred Aberdeen-Angus and dams being nondescript breeding, common to eastern Arkansas.

Lot 3, Arkansas native.

Lot 4, Arkansas native.

Lots 1, 2, and 3 were bred to a purebred Aberdeen-Angus bull, while lot 4 was bred to an Arkansas native bull.

The four lots of cows were treated as nearly alike as possible throughout the experiment. Two pastures were used. Lots 1, 2, and 3, bred to the purebred bull, were kept on one pasture; lot 4, bred to the native bull, was kept on the other pasture. The two groups were changed every 2 weeks after the beginning of the grazing season.

The calves produced from these cows were not fed any additional feed until they were weaned. Data showing the results of the calf test to weaning are shown in table 21.

Table 21. Calf data; birth to weaning, 3 years: Arkansas, 1925-1927.

	Purebred calves	Second-cross calves	First-cross calves	Native calves
Total number calves	21.0	23.0	20.0	21.0
Average birth weight, lbs.	66.9	65.7	61.5	64.2
Average age at weaning, days	226.0	223.0	212.0	217.0
Average weight at weaning, lbs.	426.2	440.0	424.0	430.9
Average daily gain to weaning, lbs.	1.59	1.68	1.71	1.69

Reference: Arkansas Agricultural Experiment Station Bulletin 247, "Beef Producing Qualities of Purebred Aberdeen-Angus Cattle Compared with Arkansas Native Cattle," pages 3, 4, and 6, tables 1, 4, and 5, Fayetteville, Arkansas, March 1931.

Creep-Feeding Beef Calves

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: 4 years, 1930-1933.

Purpose: To determine the value of creep-feeding beef calves on pasture.

Procedure and conditions: In 1930 grade Hereford, Aberdeen-Angus, and Shorthorn calves, mostly steers, were used. A mixed group by Hereford, Aberdeen-Angus, and Brahman sires were used in 1931. The calves were larger and older and made better gains than in 1930. In 1932 and 1933, Hereford and Aberdeen-Angus calves were used. Each year lot 1 was fed grain and in a creep, and lot 2 ran on pasture alone.

A ration of ground corn 2.5 parts, rice polish 2.5 parts, and cottonseed meal 1 part was fed in 1930 and 1931. As much feed was put out each day

Table 22. Creep-feeding beef calves: Louisiana, 1930-33.

	1930		1931		1932		1933		Average	
Test started	June 16		July 7		July 16		May 5			
Test closed	October 14		October 14		October 20		September 15			
No. days on test	120		99		87		133		107	
	grain	grass	grain	grass	grain	grass	grain	grass	grain	grass
No. calves per lot	10	10	10	10	9	9	10	10	10	10
Av. initial weight, lbs.	257.0	259.0	299.7	299.7	354.0	354.0	213.6	212.2	281.0	281.2
Av. final weight, lbs.	476.3	421.7	493.5	450.4	505.0	479.0	450.5	381.0	481.3	433.0
Av. gain per head, lbs.	219.3	172.7	193.8	150.8	151.0	125.0	236.9	168.8	200.2	154.3
Av. daily gain, lbs.	1.8	1.4	1.9	1.5	1.7	1.4	1.7	1.2	1.8	1.4
Total feed per head, lbs.	342.4	—	251.0	—	266.4	—	440.5	—	325.0	—
Av. feed per day, lbs.	2.8	—	2.5	—	3.0	—	3.7	—	3.3	—

as the calves would clean up. In 1932, the feed mixture was composed of equal parts ground whole ear corn or ground whole corn, wheat bran, and cottonseed meal, with about 12 percent of blackstrap molasses. A mixture of corn, rice bran, and cottonseed meal was used in 1933.

Reference: Louisiana Agricultural Experiment Station Bulletin 249, "Feeding Grain to Beef Calves on Pasture Before Weaning," pages 7, 8, 9, 10, and 11, tables 1, 2, 3, and 4, Baton Rouge, Louisiana, June 1934.

Calf Production from Purebred Polled Hereford, Grade Hereford, and Native Cattle

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1939.

Purpose: To compare different grades of cattle in producing beef calves.

Procedure and conditions: In this test purebred Polled Hereford, grade Hereford, and native cows were used. The purebred Polled Hereford cows and their calves were carried on 20 acres of green oats from March 29 to April 5, and after that date they were pastured on a 48-acre permanent pasture containing carpet grass, dallis grass, lespedeza, and white clover. Twenty acres of this pasture received 200 pounds of 43 percent superphosphate per acre; 20 acres received 100 pounds of 43 percent triple superphosphate per acre, and 8 acres received no fertilizer.

During the 226-day grazing period the purebred cows made an average daily gain of 0.451 pounds. No feed other than grazing was available to the cows during this period. The calves from the purebred cows were creep-fed.

Fifty-one grade Hereford cows and unbred heifers together with 25 suckling calves were placed on permanent pasture March 16. The 76 animals were placed on approximately 50 acres of improved pasture and 25 acres of unimproved pasture. The improved pasture was composed of carpet grass, bermuda grass, and lespedeza. The calves in this group were not creep-fed. During the 240-day grazing period the cows made an average daily gain of 0.398 pounds. The cows received no supplemental feed while on pasture.

The native herd, 39 cows and 33 calves (grade Jersey and native cattle and a few first-cross heifers), was placed on approximately 100 acres of permanent pasture on March 15. The permanent pasture was carpet, dallis, bermuda, and centipede grass, and some lespedeza. During the 238-day grazing period the cows made an average daily gain of 0.413 pounds. No supplemental feed was fed to the cows.

In 1939 the calves were carried until they reached the age of approximately 8 months and were sold as fat calves. Purebred Hereford bulls were used in breeding mated cows and first-cross heifers. When the cows were placed on permanent pasture on March 15 they were divided into two groups. Nineteen of the calves were creep-fed for 142 days beginning May 9. They were fed a ration composed of 7 parts snapped corn and 1 part peanut meal. Thirteen calves in another group, handled under similar conditions, were not creep-fed.

The results of the test are shown in table 23.

Table 23. Calf production test for spring 1939, Tifton, Ga.

	Native herd	Native herd	Grade herd*	Purebred Polled Hereford
	Calves Creep-fed	Calves not Creep-fed	Calves not Creep-fed	Calves Creep-fed
Total number calves	19	13	25	25
Date dropped	Feb. 6 to Apr. 11	Feb. 8 to Apr. 19	Feb. 2 to Apr. 11	Jan. 20 to Mar. 15
Date off test	Sept. 28	Sept. 28	Oct. 4	Oct. 11
Date creep-feeding started	May 9	—	—	May 9
Number days creep-fed	142	—	—	156
Average birth weight, lbs.	70.42	75.92	74.08	70.81
Average final weight at end of period, lbs.	461.31	309.15	375.48	482.28
Average gain per calf, lbs.	390.89	333.23	301.40	402.47
Average daily gain per calf, lbs. ..	1.82	1.63	1.38	1.83
Average daily feed consumption, lbs.	2.30	—	—	3.71
Ground snapped corn, lbs.	2.01	—	—	3.24
Peanut meal, lbs.	.29	—	—	.46
Total feed consumed per calf, lbs.	326.00	—	—	579.00
Ground snapped corn, lbs.	285.00	—	—	506.00
Peanut meal, lbs.	41.00	—	—	73.00
Feed consumed per 100 pounds gain, lbs.	83.41	—	—	142.00
Ground snapped corn, lbs.	72.99	—	—	124.00
Peanut meal, lbs.	10.42	—	—	18.00

*Calves from grade herd not sold. They were graded and priced for comparison with calves from native herd.

Reference: Georgia Coastal Plain Experiment Station Twentieth Annual Report, 1939-1940, pages 48, 49, 50, and 51, table 33, Tifton, Georgia, July, 1940.

FINISHING BEEF CALVES

Finishing beef calves is a definite part of the beef cattle production program. To be successful in this phase of business farmers may need to give careful consideration to the different methods of finishing. This phase of business may be classified as semi-specialized in that the calves require close attention and careful planning to keep the calves in a thrifty growing state.

Several experiments have been selected on this phase of business from the southern states. Information is presented in this section on a comparison of calves of different breeds for finishing, grains and protein supplement feeds, roughage feeds, and minerals.

Breeds of Beef Calves for Finishing

The producer selecting finishing calves as a part of the beef cattle production program may wish to compare different breeds of calves for this purpose. A number of experiments have been selected from Mississippi, Arkansas, and Missouri comparing the different breeds of calves in a finishing program. This information should prove helpful in determining the breed of calf to use in a finishing program.

Breeds of Polled Beef Cattle in Beef Production

Conducted by: Main Station, Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1937-1940.

Purpose: To compare native calves with calves produced from native cows bred to registered Polled Devon, Polled Shorthorn, Polled Hereford, and Aberdeen-Angus bulls.

Procedure and conditions: This experiment was set up to compare the performance of calves produced in Mississippi from six different types of parentage as to their efficiency for producing beef during a fattening period. Five lots of calves out of native Mississippi cows and sired by Native, Polled Devon, Polled Shorthorn, Polled Hereford, and Aberdeen-Angus bulls, re-

Table 24. Breeds of polled beef cattle in beef production, Mississippi, 1937-1940

	Lot 1 Native check lot	Lot 2 Polled Devon	Lot 3 Polled Short- horn	Lot 4 Polled Here- ford	Lot 5 Aber- deen- Angus	Av. of lots 2 to 5	Lot 1A High grades
Fattening Period, 1938-39 and 1939-40							
Av. initial wt., lbs.	424.00	421.00	424.00	412.00	375.00	408.00	438.00
Av. final wt., lbs.	689.00	729.00	712.00	686.00	668.00	698.00	759.00
Av. total gain on feed, lbs....	265.00	308.00	288.00	273.00	294.00	290.00	320.00
Av. daily gain on feed, lbs....	1.46	1.70	1.59	1.51	1.62	1.60	1.76
Av. daily ration,* lbs.							
Ground corn	7.51	8.12	8.16	7.38	7.66	7.84	9.04
Cottonseed cake	2.12	2.16	2.12	2.11	2.15	2.13	2.19
Sorghum silage	5.28	5.63	5.54	5.40	5.44	5.50	5.76
Lespedeza hay	1.72	1.70	1.73	1.73	1.71	1.72	1.72
Av. amt. of concentrate con- sumed per lb. of gain	6.54	6.08	6.43	6.29	6.08	6.22	6.31
Av. slaughter grade	Medium	Good	Good	Good	Good	Good	Good
Slaughter data							
Av. dress percent (cold wts.)	59.06	59.84	60.46	59.18	58.96	60.14	59.40
Av. carcass grade	Medium	Good	Good	Good	Good	Good	Good

*1/10 lb. oystershell flour fed per head daily during this period.

spectively, as well as a mixed lot of high grade Hereford and Angus calves, were used.

The calves were divided into five lots according to breeding. They were fed in individual stalls for 177 days. A ration of ground corn, cottonseed cake, sorghum silage, and lespedeza hay was fed the calves with 1.10 of a pound of oystershell flour added per head daily. The silage and lespedeza hay was limited in order to increase the consumption of corn and cottonseed cake. The results of this test are shown in table 24.

References: Mississippi Farm Research, September 1939.

Mississippi Agricultural Experiment Station Bulletin 347, "The Influence of Breeding on the Performance of Beef Calves Produced in Mississippi," pages 4, 6, 9, and 12, tables 1 and 4, State College, Mississippi, August 1940.

Finishing Purebred Aberdeen-Angus, Second Cross, First Cross, and Native Calves

Conducted by: Arkansas Agricultural Experiment Station.

Conducted at: Fayetteville, Arkansas.

Period: 1925-27.

Purpose: To compare purebred Aberdeen-Angus calves, first- and second-cross Aberdeen-Angus calves, and Arkansas native calves as a source of beef.

Procedure and conditions: Four lots of weaned calves were finished in this test on grain feeds. The calves were fed for an average of 157 days per year, beginning in the fall of 1925. The calves were sold in the spring of each year. The calves were from purebred Aberdeen-Angus, grade Aberdeen-Angus (second-cross), Arkansas native cows bred to purebred Aberdeen-Angus bulls (first-cross), and native cows bred to native bulls.

The average results of the 3-year fattening period are shown in table 25.

Table 25. Fattening period for calves: Arkansas, 1925-1927

	Purebred calves	Second-cross calves	First-cross calves	Native calves
Total number calves	21.00	23.00	20.00	21.00
Average days fed	157.00	157.00	157.00	157.00
Average initial weight, lbs.	426.20	440.30	426.00	430.20
Average final weight, lbs.	704.10	705.60	691.30	668.80
Average daily gain, lbs.	1.77	1.69	1.69	1.52
Average daily rations, lbs.				
Silage	3.40	3.30	2.90	2.90
Alfalfa hay	5.10	5.00	4.70	4.60
Cottonseed meal	2.10	2.00	2.00	1.90
Carbonaceous concentrates	8.30	8.20	8.10	7.10
Feed per 100 pounds gain, lbs.				
Silage	192.10	195.00	171.39	191.82
Alfalfa hay	288.15	295.50	277.17	302.68
Cottonseed meal	118.65	118.20	118.20	126.00
Carbonaceous concentrates	468.95	494.62	488.71	467.18

Reference: Arkansas Agricultural Experiment Station Bulletin 247, "Beef Producing Qualities of Purebred Aberdeen-Angus Cattle Compared with Arkansas Native Cattle," pages 3, 4, and 6, tables 1, 4, and 5, Fayetteville, Arkansas, March 1931.

Yearling Heifers and Steers for Beef Production

Conducted by: Missouri Agricultural Experiment Station.

Conducted at: Columbia, Missouri.

Purpose: To compare heifer calves with steers, to determine which can be produced more economically.

Period: December 21, 1925 to October, 25, 1926.

November 25, 1926 to October 27, 1927.

Procedure and conditions: Cattle of "good" to "choice" Hereford steers and open heifer calves purchased from Matador Ranch in Texas were used in the test. They were treated for blackleg and hemorrhagic septicemia on arrival at Columbia. The calves were given 1 to 3 weeks to recover from the shipment and vaccinations.

The first year feed consisted of mixed corn, No. 3 grade; old-process pea size linseed oil meal, guaranteed 34 percent protein; alfalfa hay of choice quality, and corn silage made from good corn that would yield 50 bushels per acre.

The second year the corn was mixed of No. 3 grade and the protein fed was pea sized 43 percent cottonseed meal. The hay was alfalfa of choice quality, and the corn silage was made from good 50 bushel corn. The grain ration for the 1925-26 test consisted of shelled corn 6 parts, linseed oil meal 1 part, by weight. The second year's mixture was made up of shelled corn 8 parts, cottonseed meal 1 part, by weight. Grain and silage were fed in flat-bottomed feed bunks in the lots. Hay was fed in mangers in the shed. All feeds were hand fed twice daily, in the morning and in the evening. The

Table 26. Yearlings for beef production: Missouri, 1926-27

	Full feed in dry lot		Half grain ration with hay and silage during winter. Full fed grain on grass during summer	
	Lot 1 Steers	Lot 6 Heifers	Lot 3 Steers	Lot 7 Heifers
Winter period, days	154.0	154.0	154.0	154.0
Initial weight, lbs.	358.8	357.5	358.1	353.8
Final weight, lbs.	691.1	658.7	607.5 ¹	605.8 ³
Gain, lbs.	332.3	301.2	249.5	252.1
Summer period, days	28.0	28.0	168.0	168.0
Initial weight, lbs.	611.1	658.3 ²	604.3 ²	606.2 ⁴
Final weight, lbs.	752.7	710.2	948.7	881.1
Gain, lbs.	61.6	61.6	344.3	274.9
Total for both periods				
Initial weight, lbs.	358.8	357.5	358.1	353.8
Final weight, lbs.	752.7	710.2	948.7	881.1
Gain, lbs.	393.9	352.7	593.8	527.0
Feed required to produce 100 pounds gain, lbs.				
Grain	421.7	468.2	322.6	552.2
Hay	114.6	161.9	97.0	117.9
Silage	399.5	450.4	297.0	335.8
Grass, days	—	—	168.0	168.0

¹ Average of 9 steers in winter of 1925-26.

² Average of 8 steers summer of 1925-26.

³ Average of 9 heifers in winter of 1926-27.

⁴ Average of 8 heifers in summer of 1926-27.

cattle were fed all the hay and silage they would eat from the beginning of the experiment. The corn and protein were hand mixed and fed after the silage had been eaten. Hay was fed after the grain. Salt was kept before the cattle.

Reference: Missouri Agricultural Experiment Station Bulletin 314, "Yearling Heifers and Steers for Beef Production," pages 5, 6, 12, and 14, tables 3 and 4, Columbia, Missouri.

Grain and Protein Supplements for Finishing Calves

Concentrated feeds are very important in finishing calves due to the feed consumption capacity of calves. This concentrated feed can best be supplied by grains and protein supplements. A number of experiments are given that show a comparison of different grains and protein supplements. These tests were conducted in Mississippi, West Virginia, and Oklahoma.

Delta Grown Oats and Barley versus Corn for Finishing Beef Calves

Conducted by: Main Station, Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 170 days, 1940-1941.

Purpose: To compare Delta grown oats and barley with corn for finishing beef calves.

Procedure and conditions: This test consisted of 3 lots of 12 grade beef calves each. The test was started on November 30, 1940 and ended on May 2, 1941. All calves were fed in individual stalls and separate feeding records were computed. Individual feeding records were taken on 3 consecutive days at the beginning and end of the feeding period and every 28 days throughout the test. The calves were placed on feed soon after being weaned at about 7 months of age. The calves were graded and valued at the beginning of the test and their carcasses graded at the completion of the feeding trial.

Table 27. A comparison of Delta grown oats and barley with corn for finishing calves: Mississippi, 1940-1941

	Lot 1 Corn	Lot 2 Oats	Lot 3 Barley
No. of calves per lot	12.00	12.00	12.00
Average initial weight, lbs.	430.00	429.00	429.00
Average final weight, lbs.	740.00	655.00	703.00
Av. total gain on feed, lbs.	310.00	226.00	274.00
Av. daily gain, lbs.	1.82	1.33	1.61
Av. daily ration, lbs.			
Ground corn	8.34	—	—
Ground oats	—	6.18	—
Ground barley	—	—	7.22
Cottonseed cake	1.99	1.96	1.99
Sorghum silage	5.88	5.39	5.78
Lespedeza hay	1.99	1.00	1.50
Oystershell flour	.10	.10	.10
Av. amount of concentrates per lb. of grain ..	5.67	6.12	5.71
Av. grade of feeder calves	Good	Good	Good
Av. slaughter grade of calves	Good—	Medium	Good—
Slaughter data:			
Av. dressing percent	58.98	56.15	57.11
Av. carcass grade	Good	Medium+	Good—

All the lots were fed as much grain as they would consume with a basal ration of cottonseed cake, silage, and hay. The amount of hay fed to the oats lot was reduced to one-half and that fed to the barley lot reduced to three-fourths of that fed to the corn lot in order to promote the consumption of the somewhat bulky oats and barley.

The results of the test are shown in table 27.

Reference: Mississippi Farm Research, June 1941.

Dehydrated Sweetpotatoes versus Corn for Finishing Calves

Conducted by: Main Station, Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: January 21, 1941 - May 2, 1941—101 days.

November 12, 1941 - April 3, 1942—142 days.

Purpose: To compare dehydrated sweetpotatoes with corn for fattening calves.

Procedure and conditions: During the early part of 1941 a preliminary feeding trial was carried on by the Animal Husbandry Department of the Mississippi Experiment Station to study the possibility of using dehydrated sweetpotatoes as a principal concentrate in rations for finishing calves.

Four high-grade Hereford steers were used in this preliminary test which extended over a period of 101 days. The steers were group-fed a basal ration of 2 pounds of cottonseed meal, 2 pounds of dallis grass hay, 6 pounds of sorghum silage, and one-tenth pound of oystershell flour per head daily together with all the dried sweetpotatoes they would eat in addition. Block salt was available to the calves at all times. Individual weights were taken on the

Table 28. Dehydrated sweetpotatoes versus corn for finishing calves: Mississippi 1941-1942.

	Jan. 21, 1941- May 7, 1941 101 days		Nov. 12, 1941- Apr. 3, 1942 142 days	
	Corn	Sweet- potatoes	Corn	Sweet- potatoes
No. calves per lot (steers)	10*	4	10	6
Av. initial weight, lbs.	530.00	559.00	418.00	413.00
Av. final weight, lbs.	735.00	745.00	743.00	707.00
Av. total gain on feed, lbs.	205.00	186.00	325.00	294.00
Av. daily gain, lbs.	1.80	1.84	2.29	2.07
Av. daily ration, lbs.				
Ground corn	11.21	—	10.25	—
Dehydrated sweetpotatoes	—	9.61	—	8.27
Cottonseed cake	2.00	1.99	2.00	2.70
Sorghum silage	6.00	5.97	5.96	5.93
Johnson grass hay	2.00	2.00	2.00	2.00
Oystershell flour	.10	.10	.10	.10
Av. amount concentrates per lb. gain	7.34	6.30	5.35	5.31
Av. grade of feeder calf	—	—	Good—	Good—
Av. slaughter grade	—	—	Good	Good—
Slaughter data:				
Av. dressing percent**	—	—	59.7	58.4
Av. carcass grade	—	—	Good	Good—

*Heifer calves.

**Based on warm carcass weights and final weight minus 3 percent.

steers at the beginning and end of the test and at 28-day intervals throughout the feeding period.

The dried sweetpotatoes used in this test had been produced in a drying experiment conducted on a farm near Laurel, Mississippi. This product was, for the most part, of good quality, although a small amount of scorched material was occasionally found in it.

A second feeding trial was conducted in which 6 grade steer beef calves were fed for 142 days. The usual practices for conducting a feeding trial were carried out. A summary of the two tests is given in table 28.

Reference: Mississippi Farm Research, August 1941.

Mississippi Farm Research, July 1942.

Cottonseed Cake in Rations for Finishing Beef Calves

Conducted by: Main Station, Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 170 days, 1940-1941.

Purpose: To compare varying amounts of cottonseed cake in ration for finishing beef calves.

Procedure and conditions: In this test 4 uniform lots of 10 grade heifer beef calves were used. The test extended over a period of 170 days beginning November 13, 1940 (soon after the calves were weaned at about 7 months of age) and ended on May 2, 1941. The calves were group-fed, a record being kept of the feed consumption. The calves were graded and valued at the beginning and end of the test and the carcasses graded after slaughter.

All calves received a basal ration of 6 pounds sorghum silage, 2 pounds lespedeza hay, 2 pounds ground shelled corn daily. In addition cottonseed cake was fed in approximate amounts of 8, 6, 4, and 2 pounds daily per calf to lots 4, 5, 6, and 7. Shelled corn was included in each of the rations in accordance with the appetite of the various calves in the respective lots.

The cottonseed cake was regular 41 percent nut-size commercial cake; corn was No. 2 White produced in southeastern Missouri; sorghum silage and lespedeza hay were produced on the Experiment Station farm. The lespedeza hay contained a considerable amount of grass. A small amount of oystershell flour was included in the ration. Block salt was available throughout the feeding test. The results of this test are shown in table 29.

Table 29. Varying amounts of cottonseed cake in rations for finishing calves in Mississippi, 1940-1941.

	Lot 4 Heavy cake	Lot 5 Medium heavy cake	Lot 6 Medium light cake	Lot 7 Light cake
No. calves per lot	10.00	10.00	10.00	10.00
Av. initial weight, lbs.	417.00	416.00	419.00	419.00
Av. final weight, lbs.	722.00	725.00	723.00	735.00
Av. total gain on feed, lbs.	305.00	309.00	304.00	316.00
Av. daily gain, lbs.	1.79	1.82	1.79	1.86
Av. daily ration, lbs.				
Ground corn	3.74	5.82	7.69	10.15
Cottonseed cake	7.59	5.92	3.97	1.99
Sorghum silage	5.89	5.85	5.89	5.92
Lespedeza hay	2.00	2.00	2.00	2.00
Oystershell flour	.20	.17	.13	.10
Av. amt. of concentrates per lb. of grain	6.31	6.46	6.53	6.53
Av. grade of feeder calves	Good	Good	Good	Good
Av. slaughter grade	Good	Good	Good	Good
Slaughter data:				
Av. dressing per cwt. (warm wts.) ..	58.17	60.01	60.15	60.23
Av. carcass grade	Good+	Good+	Good+	Good+

Reference: Mississippi Farm Research, July 1941.

Finishing Calves for Market as Baby Beeves

Conducted by: West Virginia Agricultural Experiment Station.

Conducted at: Morgantown, West Virginia.

Period: 6 years, 1925-1930.

Purpose: To study the place of baby beef production in beef cattle industry.

Procedure and conditions: Good grade native Hereford steer calves were used with the exception of one lot of good grade, native Aberdeen-Angus steer calves. They were all spring calves dropped from March 1 to June 1.

The calves were fed a heavy grain ration in dry lot and marketed as baby beeves when approximately 15 months of age. Corn and oats were fed in equal parts at the beginning of the test. Each 28 days the oats was gradually replaced by corn until very little oats was fed at the close of the trials. Corn silage was fed at the rate of 4 pounds per day from the start of these trials until the first of May each year, and hay was allowed at liberty throughout the period. Small quantities of molasses were fed near the close of the period in 1925, 1926, and 1929.

Two calves died during the 1927 feeding period; their deaths were probably due to mold silage which was not observed until after the calves became ill.

The winter feeding period began around the last of November or first of December and the steers were marketed from June 27 to July 27, each year.

Table 30. Calves marketed as baby beeves: West Virginia, 1925-1930.

	Average of 6 lots 1925-1930
Total number of calves	46.00
Number of days	220.00
Average initial weight, lbs.*	456.50
Average final weight, lbs.	929.00
Average gain, lbs.	472.50
Average daily gain, lbs.	2.15
Ration:	
Cracked corn, lbs.	8.11
Ground oats, lbs.	3.31
Linseed oil meal, lbs.	.99
Cottonseed meal, lbs.	.78
Molasses, lbs.	.04
Silage, lbs.	2.62
Hay, lbs.**	3.49
Feed per 100 pounds gain:	
Corn, lbs.	317.00
Ground oats, lbs.	154.00
Linseed oil meal, lbs.	46.00
Cottonseed meal, lbs.	36.00
Molasses, lbs.	1.90
Silage, lbs.	122.00
Hay, lbs.**	162.00
Total feed required:	
Cracked corn, lbs.	1,784.00
Ground oats, lbs.	728.00
Linseed oil meal, lbs.	218.00
Cottonseed meal, lbs.	171.00
Molasses, lbs.	9.00
Silage, lbs.	796.00
Hay, lbs.**	768.00

*All weights of calves and feeds are given in pounds.

**Mixed and alfalfa hay.

Reference: West Virginia Agricultural Experiment Station Bulletin 251, "Finishing Calves for the Market as Baby-Beeves, Two-Year-Old, and Three-Year-Old Steers," pages 2, 3, 4, and 5, table 1, Morgantown, West Virginia, June 1932.

Substituting Cottonseed Meal for Ground Shelled Corn in a Fattening Ration of Corn, Cottonseed Meal, and Alfalfa Hay for Steer Calves

Conducted by: Oklahoma Agricultural Experiment Station.

Conducted at: Stillwater, Oklahoma.

Period: November 19, 1931 to April 27, 1932, 169 days.

Purpose: To determine the value of substituting cottonseed meal for ground shelled corn in a winter ration for beef cattle.

Procedure and conditions: This test was conducted in the Experimental Beef Cattle Shed. Each lot was 30 feet wide by 36 feet long with a shed, 24 feet deep, across the north end.

High grade Hereford steers were used. The calves were delivered at Stillwater 10 days before the feeding trials started so that all effects of weaning and shipping would be over before the actual experiment started. All lots

were as nearly alike as was possible in regard to number, average weight, quality, condition, age, and indications of probable outcome.

All hay and other roughage was fed under the shed. Grain was fed either in movable bunks which were placed under the shed in bad weather, or in self-feeders providing 10 feet of feeder space. Water was provided from metal tanks which were located in the partition fence between the lots.

The three lots of steers were fed rations of ground shelled corn, cottonseed meal, and alfalfa hay varying only in the proportion of cottonseed meal to corn. As the amount of cottonseed meal was increased in lots 2 and 3, over the amount fed in lot 1, the amount of corn fed was reduced a corresponding amount. Thus, the total amount of concentrates fed in all lots was practically the same.

Ground limestone was fed in all lots to the extent of 2 percent of the concentrate allowance. All lots had access to common salt.

Table 31. Substituting cottonseed meal for ground shelled corn in a fattening ration for steer calves: Oklahoma, 1931-32.

	Lot 1	Lot 2	Lot 3
Number of steers per lot	8.00	8.00	8.00
Average initial weight, lbs.	363.00	355.00	362.00
Average final weight, lbs.	669.00	653.00	660.00
Average total gain, lbs.	306.00	298.00	298.00
Average daily gain, lbs.	1.81	1.76	1.76
Average daily ration: lbs.			
Ground shelled corn	6.81	6.40	4.64
Cottonseed meal (43 percent)	.15	.58	2.31
Alfalfa hay	4.15	4.14	4.14
Ground limestone	.14	.14	.14
Total concentrates per head per day, lbs.	6.96	6.98	6.95
Feed required per 100 lbs. gain:			
Concentrates, lbs.	384.00	396.60	394.90
Roughage, lbs.	299.00	235.00	235.00

Reference: Oklahoma Agricultural Experiment Station Bulletin 237, "Beef Cattle Feeding Investigations," pages 3 and 8, Stillwater, Oklahoma, November 1939.

Calves and Yearlings

Conducted by: Arizona Agricultural Experiment Station.

Conducted at: Tucson, Arizona.

Period: 1932-33.

Purpose: To compare calves with yearlings fed similar rations.

Procedure and conditions: Three lots of each class were fed No. 1, No. 2, and No. 3 alfalfa hay, respectively. Since one lot of calves and one lot of yearlings were fed one of three grades of hay, the three lots of each class were averaged for comparison. The allowance of concentrates was limited to the same amount for each group. The animals were divided into lots as evenly as possible according to individual weight, condition, type, and feeder grade.

The feed lots were unsheltered, woven-wire enclosures 48 feet by 60 feet. Each lot was equipped with automatic drinking cup, a box of block salt, and a feed trough 3 feet by 36 feet, above which was a rack for hay.

Table 32. The efficiency of fattening calves as compared with yearlings: Arizona, 1932-33.

	Calves	Yearlings
Number of steers finished	29.0	28.0
Average initial weight, lbs.	440.3	562.5
Average final weight, lbs.	683.1	809.0
Average daily gain, lbs.	2.06	2.11
Average daily ration, lbs.:		
Alfalfa hay	6.19	8.09
Hegari silage	14.37	19.12
Ground barley	3.13	3.12
Cottonseed meal	1.63	1.93
Pounds feed per 100 pounds gain:		
Alfalfa hay	301.7	282.9
Hegari silage	699.7	907.6
Ground barley	152.2	148.1
Cottonseed meal	79.2	77.4

Reference: Arizona Agricultural Experiment Station Bulletin 170, "Rations for Fattening Cattle in Arizona," pages 139 and 149, table 11, Tucson, Arizona, March 1940.

Roughages for Finishing Beef Calves

In finishing beef calves a part of the feed may be supplied in the form of roughages. By using this type of feed the cost of the ration may be reduced. Experimental tests are presented in this section giving a comparison of different roughages in finishing beef calves.

Cottonseed Hulls Compared to Prairie Hay as Roughages in Fattening Rations of Ground Shelled Corn, Cottonseed Meal, and Ground Limestone for Steer Calves

Conducted by: Oklahoma Agricultural Experiment Station.

Conducted at: Stillwater, Oklahoma.

Period: 1932-1936, average length test, 173 days.

Purpose: To compare cottonseed hulls to prairie hay as roughages in fattening rations of ground shelled corn, cottonseed meal, and ground limestone for steer calves.

Procedure and conditions: This test was conducted in the Experimental Beef Cattle Shed. Each lot was 30 feet wide by 36 feet long with a shed, 24 feet deep, across the north end.

High grade Hereford steers were used. The calves were delivered at Stillwater 10 days before the feeding trials started so that all effects of weaning and shipping would be over before the actual experiment started. All lots were as nearly alike as was possible in regard to number, average weight, quality, condition, age, and indications of probable outcome.

All hay and other roughage was fed under the shed. Grain was fed either in movable bunks which were placed under the shed in bad weather, or in self-feeders providing 10 feet of feeder space. Water was provided from metal tanks which were located in the partition fence between the lots.

Each lot was full of feed, ground shelled corn, and their respective roughage. An amount of cottonseed meal was fed that would make the nutritive ratio of both rations the same. Two percent of finely ground limestone was

mixed with the grain allowance. In addition a mineral mixture of equal parts steamed bonemeal, ground limestone, and common salt was provided at all times.

Table 33. Cottonseed hulls compared to prairie hay as roughage in fattening rations of ground shelled corn, cottonseed meal, and ground limestone for steer calves: Oklahoma, 1932-36.

	Lot 1	Lot 2
Number of steers per lot	8.0	7.4
Average initial weight, lbs.	374.60	377.20
Average final weight, lbs.	739.80	731.60
Average total gain, lbs.	365.20	359.40
Average daily gain, lbs.	2.11	2.08
Average daily ration, lbs.:		
Ground shelled corn	8.15	6.77
Cottonseed meal, (43 percent)	2.38	2.75
Prairie hay	3.90	—
Cottonseed hulls	—	5.35
Ground limestone	.20	.19
Total concentrates per head per day	10.50	9.52
Feed required per 100 lbs. gain, lbs.:		
Concentrates	497.60	458.00
Roughage	148.80	257.20
Percentage of total ration consumed as roughage	27%	36%

Reference: Oklahoma Agricultural Experiment Station Bulletin 237, "Beef Cattle Feeding Investigations," pages 3 and 13, Stillwater, Oklahoma, November 1939.

A Comparison of Four Different Roughages in Fattening Rations for Steer Calves

Conducted by: Oklahoma Agricultural Experiment Station.

Conducted at: Stillwater, Oklahoma.

Period: 1935-1936. average length of test, 166 days.

Purpose: To compare prairie hay, alfalfa hay, cottonseed hulls, and kafir silage as roughage in fattening rations for steer calves.

Procedure and conditions: This test was conducted in the Experimental Beef Cattle Shed. Each lot was 30 feet wide by 26 feet long with a shed, 24 feet deep, across the north end.

High grade Hereford steers were used. The calves were delivered at Stillwater 10 days before the feeding trials started so that all effects of weaning and shipping would be over before the actual experiment started. All lots were as nearly alike as was possible in regard to number, average weight, quality, condition, age, and indications of probable outcome.

All hay and other roughage was fed under the shed. Grain was fed either in movable bunks which were placed under the shed in bad weather, or in self-feeders providing 10 feet of feeder space. Water was provided from metal tanks which were located in the partition fence between the lots.

The four lots of steers were hand-fed grain for the first 20 days in the first trial and 28 days in the second trial, after which time the steers were placed on self-feeders and the concentrate mixture was kept before them at all times. The concentrate mixtures used were as follows:

Lot 1—Ground shelled corn 4 parts; cottonseed cake 1 part.

Lot 2—Ground shelled corn 7 parts; cottonseed cake 1 part.

Lot 3—Ground shelled corn 3 parts; cottonseed cake 1 part.

Lot 4—Ground shelled corn 4 parts; cottonseed cake 1 part.

Each lot was full fed its respective roughage at all times. Ground limestone was mixed with the grain at the rate of 2 pounds per 100 pounds of grain. In addition a mineral mixture of equal parts of steamed bonemeal, finely ground limestone, and common salt was kept before all lots. Common salt was also provided in separate boxes.

Table 34. A comparison of four different roughages in fattening rations for steer calves: Oklahoma, 1935-36.

	Lot 1	Lot 2	Lot 3	Lot 4
Number of steers per lot	8.00	8.00	7.00*	8.00
Average initial weight, lbs.	359.50	359.50	362.50	359.00
Average final weight, lbs.	764.00	773.00	737.50	733.00
Average total gain, lbs.	404.50	413.50	375.00	379.00
Average daily gain, lbs.	2.44	2.49	2.26	2.28
Average daily ration: lbs.:				
Ground shelled corn	10.27	10.74	8.40	9.68
Cottonseed cake	2.55	1.50	2.68	2.42
Prairie hay	3.20	—	—	—
Alfalfa hay	—	3.59	—	—
Cottonseed hulls	—	—	5.41	—
Kafir silage	—	—	—	7.82
Total concentrates per head per day, lbs.	12.82	12.24	11.08	12.10
Feed required per 100 lbs. gain, lbs.:				
Concentrates	525.40	491.60	490.30	530.70
Roughage	131.10	144.00	239.30	343.00

*One steer was removed from lot 3 in 1935 due to urinary calculi and another in 1936 because of pneumonia.

**One steer was lost in lot 4 in 1935 due to choking.

Reference: Oklahoma Agricultural Experiment Station Bulletin 237, "Beef Cattle Feeding Investigations," pages 3 and 15, Stillwater, Oklahoma, November 1939.

The Value of Adding Silage to Fattening Ration of Ground Shelled Corn, Cottonseed Meal, Prairie Hay, and Ground Limestone for Steer Calves

Conducted by: Oklahoma Agricultural Experiment Station.

Conducted at: Stillwater, Oklahoma.

Period: 1932-33, average length of test, 175 days.

Purpose: To determine the value of adding silage to a fattening ration of ground shelled corn, cottonseed meal, prairie hay, and ground limestone for steer calves.

Procedure and conditions: This test was conducted in the Experimental Beef Cattle Shed. Each lot was 30 feet wide by 26 feet long with a shed, 24 feet deep, across the north end.

High grade Hereford steers were used. The calves were delivered at Stillwater 10 days before the feeding trials started so that all effect of weaning and shipping would be over before the actual experiment started. All lots

were as nearly alike as was possible in regard to number, average weight, quality, condition, age, and indications of probable outcome.

All hay and other roughage was fed under the shed. Grain was fed either in movable bunks which were placed under the shed in bad weather, or in self-feeders providing 10 feet of feeder space. Water was provided from metal tanks which were located in the partition fence between the lots.

Both lots were full fed a concentrate mixture of 3 parts ground shelled corn to 1 part of 43 percent cottonseed meal, and prairie hay. In addition, lot 2 was given, twice daily, all the kafir silage the steers would clean up.

Ground limestone was mixed with the grain to the extent of 2 percent of the concentrate allowance. Both lots had access to common salt at all times.

Table 35. The value of adding silage to a fattening ration for steer calves: Oklahoma, 1932-1933.

	Lot 1	Lot 2
Number of steers per lot	8.00	8.00
Average initial weight per steer, lbs.	388.50	386.50
Average final weight, lbs.	723.50	752.50
Average total gain, lbs.	335.00	366.00
Average daily gain, lbs.	1.91	2.09
Average daily ration, lbs.:		
Ground shelled corn	6.49	6.53
Cottonseed meal	2.17	2.18
Prairie hay	4.40	2.27
Kafir silage	—	6.67
Ground limestone	.17	.17
Total concentrates per head per day	8.66	8.71
Feed required per 100 lbs. gain, lbs.:		
Concentrates	453.40	416.70
Hay	230.40	108.60
Silage	—	319.10

Reference: Oklahoma Agricultural Experiment Station Bulletin 237, "Beef Cattle Feeding Investigations," pages 3 and 11, Stillwater, Oklahoma, November 1939.

Minerals

Some experimental work has been done to determine the value of minerals added to the finishing ration for beef calves. Some of these tests are given to show what may be expected from the use of ground limestone when fed to beef calves.

The Value of Adding Ground Limestone to a Calf Fattening Ration of Ground Shelled Corn, Cottonseed Meal, and Prairie Hay

Conducted by: Oklahoma Agricultural Experiment Station.

Conducted at: Stillwater, Oklahoma.

Period: 1930-1931, average length of test, 164 days.

Purpose To determine the value of adding limestone to a ration of ground shelled corn, cottonseed meal, and prairie hay for fattening calves.

Procedure and conditions: This test was conducted in the Experimental Beef Cattle Shed, each lot being 30 feet wide by 36 feet long with a shed, 24 feet deep, across the north end.

High grade Hereford steers were used. The calves were delivered at Stillwater 10 days before the feeding experiment started. All lots were as nearly alike as was possible in regard to number, average weight, quality, condition, age, and indications of probable outcome.

All hay and other roughage was fed under the shed. Grain was fed either in movable bunks which were placed under the shed in bad weather, or in self-feeders providing 10 feet of feeder space. Water was provided from metal tanks which were located in the partition fence between the lots.

Table 36. The value of adding ground limestone to a calf fattening ration:
Oklahoma 1930-31.

	Lot 1	Lot 2
Number of steers per lot	10.00	10.00
Average initial weight, lbs.	404.90	405.10
Average final weight, lbs.	752.80	776.80
Average total gain, lbs.	347.90	371.70
Average daily gain, lbs.	2.12	2.27
Average daily ration, lbs.:		
Ground shelled corn	8.50	8.45
Cottonseed meal	2.52	2.53
Prairie hay	5.15	5.21
Ground limestone	—	.17
Total concentrates per head per day, lbs.	11.02	10.98
Feed required per 100 lbs. gain, lbs.:		
Concentrates	519.80	483.70
Roughage	242.90	229.50
Shrink in marketing, lbs.	34.51	58.70
Dressing percentage, lbs.	58.51	58.70

Reference: Oklahoma Agricultural Experiment Station Bulletin 237, "Beef Cattle Feeding Investigations," pages 3 and 7, Stillwater, Oklahoma, November 1939.

Limestone as a Supplement Feed for Beef Cattle

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: 1932-1936.

Purpose: To determine the need of limestone as a supplement feed for beef cattle.

Procedure and conditions: The cattle used in the test were western calves. In 1932-33 they were Hereford calves raised in Texas, and in 1933-34 the animals were choice Hereford calves reported to have been raised near Wichita Falls, Texas. In 1935-36 Herefords were purchased direct from the range. They were bred by Joe Sneed in the Panhandle of Texas and were choice Herefords.

The corn fed in these trials was grown locally, and in most instances graded number three or four. It was hauled from the elevator when needed and some loads were not as good as others. However, all lots of cattle received the same grade of corn.

The hay was of good quality at all times. However, it contained a very small percentage of timothy.

The cottonseed meal was choice grade, containing 41 percent protein.

The silage was made from well-matured corn.

Table 37. Lime as a supplement feed for beef cattle: Indiana, 1932-36.

	The effect of adding limestone to a ration of shelled corn, whole soybeans, corn silage, and clover hay		The effect of adding limestone to a ration of shelled corn, cottonseed meal, corn silage, and clover hay	
	Shelled corn whole soybeans silage, clover hay, and salt	Shelled corn whole soybeans silage, clover hay, and salt	Shelled corn cottonseed meal, silage, clover hay, and salt	Shelled corn cottonseed meal, silage, clover hay, and salt
Number steers in lot	15.00	15.00	15.00	15.00
Average initial weight, lbs.	476.80	478.40	477.20	478.90
Average final weight, lbs.	978.70	982.30	1032.70	1014.30
Average gain per steer, lbs.	501.90	503.90	555.50	535.40
Average daily gain, lbs.	1.91	1.92	2.11	2.03
Feed consumed per 100 lbs. gain, lbs.:				
Shelled corn	459.69	453.73	366.62	483.67
Supplement	79.56	78.52	72.22	75.24
Silage	494.24	497.50	483.74	501.92
Clover hay	148.38	136.88	137.52	136.86
Limestone	—	5.24	—	4.85
Salt	2.53	2.44	2.25	2.04
Average daily feed, lbs.:				
Shelled corn	8.72	8.62	9.74	9.71
Supplement	1.50	1.49	1.51	1.51
Silage	9.46	9.49	10.19	10.16
Clover hay	2.77	2.58	2.86	2.75
Limestone	—	.099	—	.098
Salt	.051	.034	.033	.031

Reference: Indiana Agricultural Experiment Station Bulletin 429, "Cattle Feeding, 1932-33, 1933-34, 1934-35," pages 3, 4, 10, and 12, tables 3 and 4, Lafayette, Indiana, July 1938.

PRODUCING MATURE BEEF CATTLE

Farmers who select the production of mature beef cattle as a phase of business are confronted with the question of determining the best system to use. Mature beef cattle production may be divided into (1) beginning with the calf and producing 2-year old or 3-year old and over, and (2) purchasing feeder and stocker cattle with the idea of finishing the cattle to a heavier weight on pasture and grain.

Experiment stations in the Southern States have conducted a number of experiments dealing with the production and finishing of beef cattle by different methods. This information is presented to serve as a guide to beef cattle producers in setting up a system of production.

Producing 2-Year-Old Cattle for Market

The production of 2-year-old cattle starts with calves that are to be carried for a 2-year period. A definite system of management must be planned for getting the calves to 2-year olds. It seems important that such cattle be kept in a thrifty growing condition during the 2-year period in order that they may reach a satisfactory weight at market time.

The West Virginia Experiment Station has conducted a test on the production of 2-year-old cattle starting with weaned calves. The cattle in this test were carried through two winter and summer periods plus a finishing period after the second summer. The cattle were fed mainly a maintenance ration during the winter periods, and during the summer periods the cattle were on pasture alone. This test should serve as a guide to producers in setting up a production system with this phase of business.

Pasture seems very important in producing cattle by this method. Experiment stations have conducted experiments that show the gains that may be expected from pasture and temporary summer and winter grazing crops. The results of these tests are presented in the "Pasture and Temporary Grazing Crops" section of this publication on pages 78 to 89. It is suggested that the test on pasture and temporary summer and winter grazing crops should be taken up in connection with planning a system of management to produce 2-year-old cattle.

The cattle in the West Virginia test were carried through a finishing period on grain feed at the end of the second summer period before marketing. Producers who wish to finish 2-year-old cattle on grain before marketing can get additional information on feeding from this publication in the section, "Finishing Mature Cattle in Dry Lot."

Producing 2-year-old Cattle

Conducted by: West Virginia Agricultural Experiment Station.

Conducted at: Morgantown, West Virginia.

Period: 1925-1930.

Procedure and conditions: Good grade native Hereford steer calves were used with the exception of one lot of good grade native Aberdeen-Angus steer calves. They were all spring calves dropped from March 1 to June 1.

The steers were carried through two winters and two grazing periods and then given a short grain feeding period in dry lot. The steers were

removed from grass during the second grazing season and the second week of September and placed in dry lot and fed a full grain ration for a short feeding period (56 to 80 days).

Table 38. Calves marketed as 2-year-olds, West Virginia: 1925-26 to 1929-30.

		Average 3 lots 1925-26 to 1929-30
Number calves		22
First winter feeding period, calves		
Number of days		131.00
Average initial weight, lbs.		479.00
Average final weight, lbs.		584.00
Average gain, lbs.		105.00
Average daily gain, lbs.		0.79
Daily ration, lbs.:		
Corn		0.41
Linseed meal		0.72
Cottonseed meal		0.98
Corn silage		12.64
Hay*		4.17
Feed required per 100 lbs. gain, lbs.:		
Corn		52.00
Linseed meal		91.00
Cottonseed meal		124.00
Corn silage		1600.00
Hay*		528.00
Pasture, first summer		
Number of days		234.00
Average final weight, lbs.		818.00
Average gain, lbs.		234.00
Average daily gain, lbs.		0.99
Second winter feeding period, yearling steers		
Number days		134.00
Average final weight, lbs.		925.00
Average gain, lbs.		107.00
Average daily gain, lbs.		0.80
Daily ration, lbs.:		
Cottonseed meal		1.49
Corn silage		25.51
Mixed hay		3.89
Corn silage		3188.00
Feed per 100 pounds gain, lbs.:		
Cottonseed meal		196.00
Mixed hay		486.00
Pasture, second summer		
Number days		143.00
Average final weight, lbs.		1131.00
Average gain, lbs.		206.00
Average daily gain, lbs.		1.45
Finishing period: 2-year-old steers, dry lot		
Number days		64.00
Average final weight, lbs.		1350.00
Average gain, lbs.		219.00
Average daily gain, lbs.		3.47
Ration, lbs.:		
Cracked corn		21.47
Cottonseed meal		2.00

(Continued next page)

Table 38. Calves marketed as 2-year-olds, West Virginia: 1925-26 to 1929-30. (Continued)

	Average 3 lots 1925-26 to 1929-30
Chopped green corn	2.02
Hay**	6.18
Feed per 100 pounds gain, lbs.:	
Cracked corn	618.00
Cottonseed meal	57.60
Chopped green corn	58.00
Hay**	178.00
Summary, entire period	
Number days (total)	707.00
Average initial weight, lbs.	479.00
Average final weight, lbs.	1351.00
Average gain, lbs.	872.00
Average daily gain, lbs.	1.23
Total feed required, lbs.:	
Corn	1427.79
Chopped green corn	129.28
Corn silage	5074.18
Linseed meal	94.32
Cottonseed meal	456.04

*Mixed and alfalfa hay. **Clover and mixed hay.

Reference: West Virginia Agricultural Experiment Station Bulletin 251, "Finishing Calves for the Market as Baby-Beeves, Two-Year-Old, and Three-Year-Old Steers," pages 2, 5, 6, and 7, table 2, Morgantown, West Virginia, June 1932.

Producing Beef Cattle Over 2 Years Old

Beef cattle producers who have a considerable amount of pasture land and land available for the production of roughage feeds may wish to produce cattle over 2 years old in order to use the pasture and roughage capacity of the farm. The West Virginia Experiment Station has conducted an experiment on producing 3-year-old cattle starting with weaned calves and carrying them through three winter and three summer periods. This test should serve as an indication as to what a producer may expect from cattle handled in this manner. This test is based on feeding a maintenance ration during the winter period, depending largely on the gains made during the summer periods. This information may be supplemented by reviewing the results of the test in producing 2-year-old cattle on page 47 of this publication. It will be necessary for the producer to decide whether the cattle should be carried through a finishing period on grain after the winter and summer periods are over, before marketing.

The success of this type of cattle business seems to depend largely on utilizing cheap feeds, such as pasture and roughages. A number of experimental tests are given on gains made by cattle on pasture and temporary summer and winter grazing crops on page of this publication in the section, "Pasture and Temporary Grazing Crops." This information should be taken up in connection with producing 3-year-old cattle to determine the value of temporary summer grazing crops in supplementing pasture during the late summer and fall months. Winter feeding seems to be a critical problem with producers in this type of business. The tests on temporary winter grazing

crops should be considered to determine the amount of feed they will replace in wintering cattle and the effect on the wintering costs. These factors seem important in setting up a system of production.

In many instances cattle produced by this method are marketed direct from pasture. Some producers may wish to finish the cattle on grain for a period before marketing. Information on finishing cattle on grain in dry lot is presented on pages 60-82 of this publication in the section "Finishing Mature Cattle in Dry Lot."

Producing 3-year-old Cattle

Conducted by: West Virginia Agricultural Experiment Station.

Conducted at: Morgantown, West Virginia.

Period: 1925-1930.

Procedure and conditions: Good grade, native Hereford steer calves were used in the test. They were all spring calves dropped from March 1 to June 1.

The steers were carried through three winter feeding periods and three grazing periods and sold from grass as grass-fat steers toward the end of the third grazing season. As calves these steers were wintered to produce in the neighborhood of 100 pounds of gain. As yearlings and 2-year-olds they were wintered in a manner to produce only slight gains.

Table 39. Calves marketed as 3-year-old steers: West Virginia, 1925-1930.

	Average 2 lots 1925-1930
Total number of calves	16.00
First winter feeding period, calves	
Number days	142.00
Average initial weight, lbs.	476.00
Average final weight, lbs.	580.00
Average gain, lbs.	104.00
Average daily gain, lbs.	0.74
Ration, lbs:	
Corn silage	13.42
Mixed hay	4.04
Cottonseed meal	1.63
Feed per 100 pounds gain, lbs.:	
Corn silage	1812.00
Mixed hay	545.00
Cottonseed meal	220.00
Pasture, first summer	
Number days	223.00
Average final weight, lbs.	825.00
Average gain, lbs.	245.00
Average daily gain, lbs.	1.09
Second winter feeding period, yearlings	
Number days	126.00
Average final weight, lbs.	849.50
Average gain, lbs.	24.50
Average daily gain, lbs.	.19
Ration, lbs:	
Corn silage	24.22
Mixed hay	2.02
Cottonseed meal	1.01

(Continued next page)

Table 39. Calves marketed as 3-year-old steers: West Virginia, 1925-1930. (Continued)

	Average 2 lots 1925-1930
Feed per 100 pounds gain, lbs.:	
Corn silage	12740.00
Mixed hay	1062.00
Cottonseed meal	531.00
Pasture, second summer	
Number days	240.00
Average final weight, lbs.	1105.50
Average gain, lbs.	256.00
Average daily gain, lbs.	1.07
Third winter feeding period, 2-year-old steers	
Number days	128.00
Average final weight, lbs.	1138.00
Average gain, lbs.	32.50
Average daily gain, lbs.	.25
Ration, lbs:	
Corn silage	25.00
Oat straw	3.76
Hay*	1.73
Cottonseed meal	1.00
Feed per 100 pounds gain, lbs.:	
Corn silage	10000.00
Oat straw	1504.00
Hay*	692.00
Cottonseed meal	400.00
Pasture, third summer	
Number days	146.00
Average final weight, lbs.	1394.00
Average gain, lbs.	256.00
Average daily gain, lbs.	1.82
Summary, entire period	
Number days	1005.00
Average initial weight, lbs.	476.00
Average final weight, lbs.	1395.00
Average gain, lbs.:	919.00
Average daily gain, lbs.	0.914
Total feed required, lbs.:	
Corn silage	8157.36
Mixed hay*	1069.82
Cottonseed meal	486.72
Oat straw	481.28

*Alfalfa and mixed hay.

Reference: West Virginia Agricultural Experiment Station Bulletin 251, "Finishing Calves for the Market as Baby-Beeves, Two-Year-Old, and Three-Year-Old Steers, pages 2, 8, 9, and 10, table 3, Morgantown, West Virginia, June 1932.

Finishing Mature Cattle on Pasture and Grain

Beef cattle producers very often purchase mature cattle expecting to finish the cattle on pasture. The producer purchasing mature cattle to finish on pasture has the choice of buying in the fall of the year, which will require wintering the cattle, or purchasing in the spring. It seems advisable for a producer to examine price quotations of feeder and stocker cattle during the

different periods of the year before deciding on the time to purchase cattle. Monthly prices, of feeder and stocker cattle by grades, are given in the market section of this publication. It will be necessary to figure the wintering cost of cattle purchased in the fall in order to make a comparison with the returns from cattle purchased in the spring.

Some producers finish the cattle on pasture alone while others finish on pasture supplemented with grain. A combination that is used in finishing cattle on pasture is that of finishing on pasture alone and on pasture plus grain, the cattle being marketed in July; and finishing on pasture alone and pasture plus grain, the cattle being marketed in the fall of the year. A combination of these methods may be used by producers who have an abundance of grass in pastures during the spring and early summer months with a reduction of grass in pastures during the late summer and fall months. By using this combination of methods the producer is able to make maximum use of the available pasture land.

Producers purchasing cattle in the fall to finish the following summer on pasture should work out an economical system of winter feeding that will maintain the cattle. Experimental tests on wintering mature cattle are given in the "Pasture and Temporary Grazing Crops" section of this publication. The tests on winter grazing crops should be helpful also in planning a winter feeding program. The results of the winter feeding periods in the tests from West Virginia, in the section of this publication on "Producing 2-Year-Old Cattle" and "Producing 3-Year-Old Cattle" should also be helpful. By making a thorough study of all these tests a producer should be in a much better position to select a system of winter feeding that will maintain the cattle as well as be economical.

Experiment stations have conducted tests on finishing cattle on pasture alone and pasture plus grain marketed in July and in the fall of the year. These tests are given to serve as a guide to producers in setting up a system of management for finishing mature cattle on pasture.

The experiments given on pasture and summer and winter temporary grazing crops on pages 83-94 of this publication should prove helpful in planning the production program for this phase of business. Consideration should be given to the advantages of improved pasture and the use of supplementary summer grazing crops.

Cottonseed Meal for Mature Steers on Pasture

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1933-35.

Purpose: To determine the economy of feeding cottonseed meal to steers on pasture; to determine the amounts of cottonseed meal or cake feeding most economical and to determine the most profitable length of feeding period.

Procedure and conditions: This experiment was conducted over a 3-year period, 1933-1935. The 1933 experiment was divided into two periods with 24 steers in each of the three lots. The steers in this experiment were predominately of Jersey breeding, locally known as "Yellow Hammers." On August 11 each lot was divided into two groups of 12 steers each. One group was marketed on August 14 and the remaining groups referred to as lots

1A, 2A, and 3A were continued on the experiment until October 3. Lot 1 in this experiment received 5 pounds cottonseed cake per steer per day in addition to pasture. Lot 2 received $2\frac{1}{2}$ pounds per steer and lot 3 received pasture alone. The steers in this experiment were not alternated from one pasture to another; each lot remained in the same pasture throughout the experiment.

In 1934, 2-year-old common grade steers were used, practically all being first cross from native or Jersey cows sired by an Angus bull. In the 1935 experiment 2-year-old good grade Hereford steers including a few crossbreeds were used. The steers in these experiments were fed cottonseed meal as in the 1933 experiment. The steers in these experiments were changed within the three pastures each 21 days, that is, at the end of the first 21-day period, lot 1 was put in the pasture that had been occupied by lot 2, putting lot 2 where lot 3 had been and putting lot 3 where lot 1 had been. This was done in order to eliminate any advantages in quality or quantity of grass that might have existed in any of the three pastures.

The cottonseed meal was fed once daily, about 8 a. m. in open troughs 4 feet wide and of sufficient length to accommodate all the cattle. Rock salt was available at all times; no other minerals were used.

These tests were conducted on pastures at State College and are representative of the better pastures in the Northeast Prairie section. From the beginning of the grazing period to May 15, approximately 90 percent of the pasture was yellow hop clover; the remaining 10 percent consisted of wild barley, cheat, white clover, and black medic. From about May 15 through the remainder of the grazing season dallis grass furnished about 80 percent of the grazing; small amounts of bermuda grass, crab grass, and lespedeza were present. There was an abundance of grazing at all times except for a brief dry period from June 25 to July 12, 1933.

Table 40. Cottonseed meal for mature steers on pasture: Mississippi, 1933-1935

	Jersey steers						First cross steers ³						Hereford steers ⁴			
	Short period ¹			Long period ²			Lot 1			Lot 2			Lot 1		Lot 2	
	Lot 1	Lot 2	Lot 3	Lot 1A	Lot 2A	Lot 3A	Lot 1	Lot 2	Lot 3	Lot 1	Lot 2	Lot 3	Lot 1	Lot 2	Lot 1	Lot 2
	5 lbs. c.s. cake	2 1/2 lbs c.s. cake	Pas- ture only	5 lbs. c.s. cake	2 1/2 lbs c.s. cake	Pas- ture only	5 lbs. c.s. cake	2 1/2 lbs c.s. cake	Pas- ture only	5 lbs. c.s. cake	2 1/2 lbs c.s. cake	Pas- ture only	5 lbs. c.s. cake	2 1/2 lbs c.s. cake	5 lbs. c.s. cake	2 1/2 lbs c.s. cake
Number steers per lot	12	12	12	12	12	12	10	10	10	10	10	10	10	10	10	10
Average initial weight, lbs.	515.5	507.6	501.2	491.1	489.0	501.2	702.5	701.0	701.5	673.0	680.5	677.0	673.0	680.5	673.0	677.0
Average final weight, lbs.	735.0	721.2	717.1	793.3	795.8	787.9	923.5	921.0	909.0	941.5	910.5	901.7	941.5	910.5	941.5	901.7
Total gain per steer, lbs.	219.5	213.6	215.9	302.2	306.8	286.7	221.0	220.0	207.5	268.5	230.0	224.7	268.5	230.0	268.5	224.7
Average daily gain, lbs.	1.93	1.89	1.91	1.82	1.84	1.72	1.82	1.81	1.71	2.02	1.73	1.69	2.02	1.73	2.02	1.69
Supplement required per 100 pounds gain, lbs.	257.4	132.2	—	274.6	135.2	—	273.7	137.5	—	247.7	144.5	—	247.7	144.5	247.7	144.5
Shrink in marketing, percent	6.1	5.12	5.31	4.79	5.98	5.20	—	—	—	4.8	5.5	—	4.8	5.5	4.8	5.5

¹Feeding and grazing period: April 20 to August 11, 1933—113 days.²Feeding and grazing period: April 20 to October 3, 1933—166 days.³Feeding and grazing period: May 2 to August 21, 1934—121 days.⁴Feeding and grazing period: April 16 to August 26, 1935—133 days.

Reference: Mississippi Farm Research Volume 2, Number 5, "Cottonseed Meal or Cake to Mature Steers on Pasture," pages 3 and 4, State College, Mississippi, May 1939.

Finishing Steers for the July versus September Markets

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Kirkwood Plantation, Faunsdale, Alabama.

Period: Three summers.

Purpose: To compare two systems of management, namely, the feeding of cottonseed meal to steers on pasture and selling the steers in July versus the fattening of steers on pasture alone and selling them in September.

Procedure and conditions: All steers used were 2-year-old high grade Herefords. They were strong and thrifty at the beginning of the experiment.

Each group of steers was turned into a large Black Belt pasture where there was an abundance of grass at all times. The pastures were composed mostly of black medic, dallis grass, white clover, and bermuda grass. Steers in lot 1 received in addition to pasture an average allowance of 4.69 pounds of 7 percent cottonseed meal per head daily. Steers in lot 2 (check lot) were on pasture with no supplement. Steers in lots 1 and 2 were sold in July; lot 3 were on pasture with no supplement and were sold in September.

Table 41. Finishing steers for July versus September markets: Alabama, 1930-1932.

	1930	1931	1932	Average
Lot 1				
Number steers	26.00	20.00	25.00	71.00
Days on pasture	77.00	96.00	98.00	90.33
Average initial weight, lbs.	568.00	654.00	659.00	627.00
Total gain per steer, lbs.	202.00	240.00	209.00	217.00
Daily gain per steer, lbs.	2.63	2.50	2.13	2.42
Cottonseed meal per steer daily, lbs.	4.69	4.69	4.69	4.69
Lot 2				
Number steers	26.00	10.00	26.00	62.00
Days on pasture	77.00	96.00	98.00	90.33
Average initial weight, lbs.	562.00	663.00	661.00	629.00
Total gain per steer, lbs.	183.00	202.00	115.00	167.00
Daily gain per steer, lbs.	2.38	2.11	1.18	1.89
Lot 3				
Number steers	19.00	10.00	26.00	55.00
Days on pasture	169.00	147.00	147.00	154.00
Average initial weight, lbs.	556.00	663.00	661.00	627.00
Total gain per steer, lbs.	288.00	269.00	218.00	258.00
Daily gain per steer, lbs.	1.70	1.83	1.49	1.67

Reference: Alabama Agricultural Experiment Station Circular 72, "Cottonseed Meal As a Supplement to Pasture for Fattening Steers in the Black Belt of Alabama," pages 4 and 8, table 5, Auburn, Alabama, March 1935.

Yearling Steers Fed Grain on Grass Compared with Grass Alone

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: February 21 to October 17, 1928.

Purpose: To determine whether it is profitable to feed grain to yearling steers on pasture as compared to grass alone.

Procedure and conditions: The steers in this test were approximately 12 months old at the beginning of the test. The steers were grade Herefords, Aberdeen-Angus, and Shorthorns grading medium to good in thin condition.

The steers were fed brewer's rice supplemented with cottonseed meal. A small amount of molasses was added during part of the test. The steers were

fed some hay from the beginning of the test until the first week in April.

Grasses on the pasture were made up mainly of white clover and bermuda grass. The steers on grass alone were not confined to one area but were moved around during the summer to such fields as would afford them good grazing. The steers receiving grain were pastured on a 10-acre field close to the feed house. Both lots had plenty of grass at all times.

Table 42 gives the results of the test.

Table 42. Yearling steers fed grain on grass compared with grass alone: Louisiana, 1928.

	Lot 1	Lot 2
	Grain on grass	Grass alone
Number in lot	9.00	9.00
Average initial weight, lbs.	415.10	402.00
Average final weight, lbs.	790.20	620.00
Average gain, lbs.	375.10	218.00
Average daily gain, lbs.	1.57	.91
Average daily ration, lbs.:		
Brewer's rice	3.50	—
Cottonseed meal	.52	—
Molasses	.176	—
Hay	1.117	1.134
Feed per 100 pounds gain, lbs.:		
Brewer's rice	223.10	—
Cottonseed meal	33.00	—
Molasses	11.20	—
Hay	71.00	124.30

Reference: Louisiana Agricultural Experiment Station Bulletin 296, "Fattening Steers of Different Ages on Pasture, With and Without Grain, and Influence of Method on Quality of Meat," pages 16 and 18, table 4, Baton Rouge, Louisiana, April 1938.

Fattening 2-year-old Steers with Grain on Grass and Grass Alone

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: March 21 to August 16, 1930.

March 21 to November 1, 1930.

Purpose To compare feeding of 2-year-old steers with grain on grass with grass alone.

Procedure and conditions: The 2-year-old steers used in this test were high grade Herefords raised in Texas but were carried through one summer in south Louisiana. The yearlings used were from the University farm and were high grade by Hereford, Shorthorn, and Aberdeen-Angus sires.

The cattle in lots 1, 2B, and 3 were put on test March 21 and sold August 16. The cattle in lot 2A were allowed to remain on pasture until November 1.

An attempt was made in this test to limit the pasture to what the steers would actually use. Some trouble was encountered from the middle of May to the middle of July on account of dry weather. The cattle in lot 2 were removed to another pasture for 2 weeks in July.

The cattle were fed corn supplemented with cottonseed meal. The results of the test are shown in table 43.

Table 43. Fattening 2-year-old steers with grain on grass and grass alone: Louisiana, 1930.

	Lot 1	Lot 2A	Lot 2B	Lot 3
	Grain on grass	Grass alone	Grass alone	Grain on grass
Number in lot	10.00	5.00	5.00	10.00
Age of steers	2 years	2 years	2 years	yearlings
Total days	146.00	224.00	146.00	146.00
Acres pasture per head (est.)	.50	1.10	1.10	.40
Average initial weight, lbs.	472.90	514.00	459.80	389.30
Average final weight, lbs.	765.10	670.60	743.00	621.90
Average gain, lbs.	292.20	156.60	283.20	232.60
Average daily gain, lbs.	1.97	1.06	1.25	1.57
Average daily feed, lbs.:				
Corn	5.45	—	—	4.89
Cottonseed meal	1.72	—	—	1.59
Feed per 100 lbs. gain, lbs.:				
Corn	276.10	—	—	310.90
Cottonseed meal	87.10	—	—	100.90

Reference: Louisiana Agricultural Experiment Station Bulletin 296, "Fattening Steers of Different Ages on Pasture, With and Without Grain, and Influence of Method on Quality of Meat," pages 22, 23, and 25, table 8, Baton Rouge, Louisiana, April 1938.

Fattening 2-year-old Steers with Grain on Grass Compared to Grass Alone in Short versus Long Grazing Period

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: 1931.

Purpose: To compare the wintering of 2-year-old steers with grain on grass to grass alone and short versus long grazing period.

Table 44. Fattening 2-year-old steers with grain on grass compared to grass alone in short versus long grazing period: Louisiana, 1931.

	Lot 1	Lot 2A	Lot 2B
	Grain on grass	Grass alone	Grass alone
Age of cattle, years	short 2	short 2	short 2
Number in lot	9.00	3.00	4.00
Number days on test	119.00	119.00	217.00
Average initial weight, lbs.	480.30	483.00	494.00
Average final weight, lbs.	719.70	720.00	792.00
Average gain, lbs.	239.40	237.00	298.00
Average daily gain, lbs.	2.01	1.99	1.37
Average daily feed, lbs.:			
Corn			
Ground whole ear (1.72)	1.26	—	—
Corn chop	.82	—	—
Rice bran	.84	—	—
Cottonseed meal	1.13	—	—
Molasses	.73	—	—
Feed per 100 lbs. gain, lbs.:			
Corn, shelled basis			
Ground whole ear (85.5)	63.3	—	—
Corn chop	40.7	—	—
Rice bran	41.6	—	—
Cottonseed meal	56.0	—	—
Molasses	36.4	—	—

Procedure and conditions: The steers used in this test were high grade Herefords purchased in Texas during the summer of 1930. The steers were very thin in the spring of 1931 and were probably not quite 2 years old when put on test.

The pastures during this test were exceedingly good, the white clover being so abundant that a great deal of trouble was encountered from bloat. In lot 2, on pasture alone, two of the steers died from clover bloat leaving only seven steers in the lot. Lot 2A was marketed July 11; the steers in lot 2B were continued until October 17. Lot 1 was fed a mixture of ground whole ear corn, corn chops, rice bran, cottonseed meal, and molasses in addition to pasture.

The results of the test are shown in table 44.

Reference: Louisiana Agricultural Experiment Station Bulletin 296, "Fattening Steers of Different Ages on Pasture, With and Without Grain, and Influence of Method on Quality of Meat," pages 26, 27, and 29, table 11, Baton Rouge, Louisiana, April 1938.

Fattening 2-year-old Steers with Grain on Grass Compared to Grass Alone and Yearling Steers with Grain on Grass

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: March 20 to July 13, 1929.

Purpose: To compare feeding of steers with grain on grass with grass alone.

Procedure and conditions: Cattle in lots 1 and 2 were purchased locally near the University. They were of mixed breeding but largely of high grade Aberdeen-Angus, Hereford, and Shorthorns. The yearling steers in lot 3 were good grade beef calves raised on the University farm in 1928. They had been wintered on a velvet bean field early in the winter, continuing after January with hay with a small amount of cottonseed meal. The pasture in this test was made up of a mixture of white clover, bermuda, and some mixed grass, mostly dallis and Vasey grasses. Lots 1 and 3 had approximately 10 acres

Table 45. Fattening 2-year-old steers with grain on grass compared to grass alone and yearling steers with grain on grass: Louisiana, 1929.

	Lot 1	Lot 2	Lot 3
	Grain on grass	Grass alone	Grain on grass
March 20 to July 13—115 days			
Number in lot	10.00	10.00	9.00
Age of steers	2 years	2 years	yearlings
Average days on pasture	115.00	115.00	115.00
Average final weight, lbs.	818.70	757.50	769.40
Average gain, lbs.	248.40	183.70	254.70
Average daily gain, lbs.	2.16	1.60	2.21
Average daily feed, lbs.:			
Brewer's rice	4.77	—	4.78
Cottonseed meal	1.37	—	1.42
Hay (fed to April 9)	.53	.61	.59
Feed per 100 pounds gain, lbs.:			
Brewer's rice	220.80	—	215.70
Cottonseed meal	63.60	—	63.90
Hay	24.50	38.10	26.70

each of fenced pasture while the steers on pasture alone ran with other cattle, principally yearling heifers, wherever they would have plenty of grass.

The cattle were fed brewer's rice supplemented with cottonseed meal; a small amount of hay was fed during the first 20 days of the test.

The results of the test are given in table 45.

Reference: Louisiana Agricultural Experiment Station Bulletin 296, "Fattening Steers of Different Ages on Pasture, With and Without Grain, and Influence of Method on Quality of Meat," pages 19 and 21, table 6, Baton Rouge, Louisiana, April 1938.

Finishing 2-year-old Steers with Grass and Grain

Conducted by: West Virginia Agricultural Experiment Station.

Conducted at: Morgantown, West Virginia.

Period: 1930-1933.

Procedure and conditions: Thirty head of native, grade yearling Hereford steers were purchased each fall. The steers were removed from pasture and started on a wintering ration around the middle of December.

Table 46. Finishing 2-year-old steers with grass and grain: West Virginia, 1930-1933.

	Lot 1	Lot 2	Lot 3
Winter feeding period (Dec. 16 to Apr. 21) 126 days			
Number days	10.00	10.00	10.00
Number steers	126.00	126.00	126.00
Average initial weight, lbs.	624.80	636.80	660.20
Average final weight, lbs.	790.10	790.10	785.50
Average gain, lbs.	147.30	153.30	125.30
Average daily gain, lbs.	1.17	1.21	1.00
Ration, lbs.:			
Corn silage	20.00	20.00	20.00
Mixed hay	3.00	3.00	3.00
Oat straw	3.00	3.00	3.00
Cottonseed meal	1.60	1.60	1.60
Grazing period (April 22 to Sept. 8) 140 days			
Average initial weight, lbs.	790.10	790.10	785.50
Average final weight, lbs.	1039.90	1030.90	1012.00
Average gain, lbs.	249.80	240.80	226.50
Average daily gain, lbs.	1.78	1.72	1.62
Ration, lbs.:			
Pasture			
Cracked corn (84 days)	4.29 (56 da.)	6.43	No grain
Cottonseed meal	0.71	1.07	—
Finishing period (Sept. 9 to Nov. 3) 56 days			
Average initial weight, lbs.	1039.90	1030.90	1012.00
Average final weight, lbs.	1165.90	1160.10	1166.00
Average gain, lbs.	126.00	129.20	154.00
Average daily gain, lbs.	2.25	2.30	2.75
Ration, lbs.:			
Pasture			
Mixed hay	—	—	8.00
Cracked corn	15.68	15.68	17.58
Cottonseed meal	2.64	2.64	2.96
Summary of grazing and finishing periods: 196 days.			
Average initial weight, lbs.	790.10	790.10	785.50
Average final weight, lbs.	1165.90	1160.10	1166.00
Average gain, lbs.	375.80	270.00	380.50
Average daily gain, lbs.	1.91	1.89	1.94

The steers were wintered in one lot each year so that they would be of the same flesh and on the same level of nutrition at the beginning of the pasture season. The winter rations were sufficient for growth and development.

After the wintering period (126 days) for each trial, the steers were graded as feeder steers and divided according to weights, grades, and condition into three lots of 10 head each and designated as lots 1, 2, and 3, and turned on pasture. Each year after the steers had been on pasture 56 days, lot 1 received 5 pounds of grain per day per steer; after 84 days lot 2 received $7\frac{1}{2}$ pounds of grain per day, and lot 3 received no grain supplement. Near the end of the better grazing season, or 140 days after the steers were turned on pasture, all lots were fed a full grain ration for a period of 56 days. The steers in lots 1 and 2 were continued on pasture and their grain ration was increased to full feed. The steers in lot 3 which did not receive grain in connection with pasture were removed from pasture and fed a full grain ration with a mixed hay (clover and timothy) replacing pasture.

The steers were wintered in an open shed with a small outside runway. Water and salt were before the steers at all times during their confinement and while on pasture they were salted once a week. Running water from a spring and branch was available while on pasture.

Reference: West Virginia Agricultural Experiment Station Bulletin 296, "Finishing Two-Year-Old Steers with Grass and Grain," pages 2, 3, and 6, table 3, Morgantown, West Virginia, October 1940.

Finishing Mature Cattle in Dry Lot

Farmers often finish mature cattle on grain feeds in dry lot before marketing. This practice may be followed with either home-grown or purchased stock. In following this practice producers are able to utilize available grain and roughage feeds. The success in finishing cattle by this method depends somewhat on selecting or preparing a ration that will give economical gains.

Experiment stations have conducted a number of tests on finishing cattle in dry lot. These tests involve comparisons of grains, protein supplements, and roughage feeds for finishing cattle. Experimental tests are presented on grains, protein supplements, and roughage feeds, which should prove helpful in determining the most economical feeds to use in finishing mature cattle.

GRAINS FOR FINISHING MATURE CATTLE

In finishing mature cattle in dry lot, grain feed will constitute an important part of the ration. There are a number of grains that can be used in cattle feeding. The more common grains available in Mississippi are corn and oats, and for the last few years, in some sections, barley is available. In some cases it may be possible to substitute molasses for a part of the grain fed.

Experimental tests are presented in this section comparing corn, oats, barley, and molasses, and in these tests comparisons are also made of different methods of preparing the grains. This information should prove helpful in deciding the grain or combination of grains to use in the finishing ration.

Oats as a Substitute for Corn for Fattening Cattle

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: 1928-29 to 1930-31.

Purpose: To determine the extent to which oats can profitably replace

corn in a ration of shelled corn, cottonseed meal, corn silage, and clover hay.

Procedure and conditions: The cattle used in the first test were grade Herefords that were very heavy boned, rugged cattle, somewhat nervous in disposition, of medium and good quality, and in rather strong feeder condition. The cattle of the second trial were grade Shorthorns of medium quality and fairly good color. They appeared to be rugged, thrifty cattle that would make satisfactory gains. All were gentle. In the third test the cattle were grade Herefords of medium to good quality that appeared to be above the average in gaining ability. All cattle were kept in open sheds similar in size and equipment.

The corn fed was grown locally and contained more moisture than is normally found in such seasons of the year. None of it would grade No. 3 but was reasonably free from damaged grains. The cottonseed meal was choice grade, containing 41 percent protein. The clover hay was of good quality but contained a slight mixture of timothy. The silage was made from corn harvested at an early corn cutting stage with the lower plants beginning to turn brown.

Table 47 gives the results of the test.

Table 47. Oats as a substitute for corn for fattening cattle: Indiana, 1928-29 to 1930-31.

	Lot 1	Lot 3	Lot 4
	Medium ground oats cottonseed meal corn silage, clover hay	Shelled corn 2/3, medium ground oats 1/3, cotton- seed meal, corn silage, clover hay, salt	Shelled corn, cottonseed meal corn silage, clover hay, salt
Number animals in lot	10.00	10.00	10.00
Average initial weight, lbs.	997.60	994.80	993.00
Average final weight, lbs.	1325.90	1339.90	1318.30
Average total gain, lbs.	328.30	345.10	325.30
Average daily gain, lbs.	2.19	2.31	2.18
Total feed consumed, lbs.:			
Shelled corn	—	12786.00	19198.00
Oats	18206.00	6326.00	—
Cottonseed meal	3885.00	3891.00	3894.00
Corn silage	43860.00	43473.00	43905.00
Clover hay	3757.00	4627.00	5133.00
Salt	75.00	75.00	75.00
Average daily feed, lbs.:			
Shelled corn	—	8.52	12.80
Oats	12.14	4.22	—
Cottonseed meal	2.59	2.59	2.60
Corn silage	29.24	28.98	29.27
Clover hay	2.50	3.08	3.42
Feed per 100 lbs. gain, lbs.:			
Shelled corn	—	370.50	590.16
Oats	554.55	183.31	—
Cottonseed meal	118.34	112.75	119.70
Silage	1335.97	1259.72	1349.68
Clover hay	114.44	134.08	157.79
Salt	2.28	2.17	2.31

Reference: Indiana Agricultural Experiment Station Bulletin 371, "Cattle Feeding, Winter Steer Feeding, pages 3, 4, and 6, table 1, Lafayette, Indiana, January 1933.

The Value of Oats Ground to Different Degrees of Fineness for Fattening Cattle

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: 1928-29 to 1930-31.

Purpose: To determine the value of oats ground to different degrees of fineness in fattening cattle.

Procedure and conditions: The cattle used in the first test were grade Herefords that were very heavy boned, rugged cattle, somewhat nervous in disposition, of medium and good quality, and in rather strong feeder condition. The cattle of the second trial were grade Shorthorns of medium quality and fairly good color. They appeared to be rugged, thrifty cattle that would make satisfactory gains. All were gentle. In the third test the cattle were grade Herefords of medium to good quality that appeared to be above the average in gaining ability. All cattle were kept in open sheds similar in size and equipment.

Four groups of cattle received a grain mixture of two parts by weight of shelled corn and one part by weight of oats with clover hay and corn silage for roughage. The only difference between the rations was in the preparation of oats. In lot 6, the oats were fed whole; in lot 2 they were fine-ground (passed through a 1/16-inch screen); in lot 7 they were medium-ground (passed through 1/8-inch screen), and in lot 5 they were coarse-ground (passed through a 1/4-inch screen).

Table 48. The value of fattening cattle on oats ground to different degrees of fineness: Indiana, 1928-29 to 1930-31.

	Lot 6	Lot 5	Lot 7	Lot 2
	Shelled corn 2/3 whole oats 1/3 corn silage, clover hay, salt	Shelled corn 2/3 coarse ground oats 1/3, corn silage, clover hay, salt	Shelled corn 2/3 medium ground oats 1/3, corn silage, clover hay, salt	Shelled corn 2/3 fine ground oats 1/3, corn silage, clover hay, salt
Number animals in lot	10.00	10.00	10.00	10.00
Average initial weight, lbs.	996.60	996.80	993.00	994.80
Average final weight, lbs.	1285.20	1304.70	1308.60	1287.20
Average total gain, lbs.	288.70	307.90	315.20	292.40
Average daily gain, lbs.	1.93	2.06	2.11	1.95
Total feed consumed, lbs.:				
Shelled corn	14540.00	14572.00	14599.00	14610.00
Oats	7276.50	7286.20	7299.50	7302.00
Corn silage	42026.00	41990.00	43878.00	42240.00
Clover hay	4873.00	4550.00	5208.00	4956.00
Salt	78.00	75.00	75.00	73.00
Average daily feed, lbs.:				
Shelled corn	9.69	9.71	9.73	9.74
Oats	4.85	4.86	4.87	4.87
Corn silage	28.02	27.99	29.25	28.16
Clover hay	3.25	3.03	3.47	3.30
Feed per 100 lbs. gain, lbs.:				
Shelled corn	305.64	472.27	463.17	499.66
Oats	252.04	236.64	231.58	249.73
Silage	1455.70	1363.75	1392.07	1444.60
Clover hay	168.79	147.78	165.23	169.49
Salt	2.70	2.44	2.38	2.50

The corn fed was grown locally and contained more moisture than is normally found in such seasons of the year. None of it would grade No. 3 but was reasonably free from damaged grains. The cottonseed meal was choice grade, containing 41 percent protein. The clover hay was of good quality but contained a slight mixture of timothy. The silage was made from corn harvested at early corn cutting stage with the lower plants beginning to turn brown.

The results of the test are shown in table 48.

Reference: Indiana Agricultural Experiment Station Bulletin 371, Cattle Feeding, Winter Steer Feeding," pages 3, 4, and 8, table 2, Lafayette, Indiana, January 1933.

Molasses as a Substitute for Corn for Full-Fed Cattle

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: 1936-37, November 25, 1936-May 24, 1937 (180 days).

Procedure and conditions: Two-year-old feeding grade Hereford steers purchased on the Chicago market in November were used in this test. They were fed silage, straw, and hay until started on the experiment November 25, 1936.

The corn and hay fed were a good quality, oats were very heavy, and the cottonseed meal was guaranteed to contain 41 percent protein. The molasses was a cane product; the silage was extra good and contained more than the normal proportion of ears to the stalk. The wheat straw was very bright.

Table 49. Molasses as a substitute for corn for full-fed cattle.

	Lot 4	Lot 5	Lot 6	Lot 7
	Shelled corn cottonseed meal silage clover hay salt	Shelled corn cottonseed meal molasses silage clover hay salt	Shelled corn cottonseed meal molasses silage clover hay salt	Ground oats cottonseed meal molasses silage clover hay salt
Number steers in lot	10.00	10.00	10.00	10.00
Average initial weight, lbs.	834.70	831.70	832.30	839.70
Average final weight, lbs.	1262.70	1244.30	1273.00	1272.00
Average gain per steer, lbs.	428.00	412.60	440.70	432.30
Average daily gain, lbs.	2.38	2.29	2.45	2.40
Feed consumed per 100 lbs. gain, lbs.:				
Shelled corn	553.62	449.83	421.15	—
Ground oats	—	—	—	278.05
Supplement	100.00	103.73	97.12	99.01
Molasses	—	131.91	194.09	276.12
Silage	831.38	853.73	789.09	826.51
Hay	130.68	131.99	115.20	130.37
Salt	1.17	0.24	0.23	0.36
Average daily feed, lbs.:				
Shelled corn	13.16	10.31	10.31	—
Ground oats	—	—	—	6.68
Supplement	2.38	2.38	2.38	2.38
Molasses	—	3.02	4.75	6.63
Silage	19.53	19.57	19.32	19.85
Hay	3.11	3.03	2.82	3.13
Salt	.028	.006	.006	.011

Reference: Indiana Agricultural Experiment Station Bulletin 430, "Cattle Feeding 1936-37, Cane Molasses," pages 3 and 5, table 1, Lafayette, Indiana. July 1938.

Blackstrap Molasses for Fattening Steers

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 3 years, December 10, 1925 to March 22, 1926.

December 19, 1926 to April 9, 1927.

December 18, 1927 to April 7, 1928.

Purpose: To determine the value of molasses as an economical supplement to a ration of cottonseed meal and Johnson grass hay.

Procedure and conditions: High grade Hereford steers were used in the test. In 1925 they were 3 years old, but in 1926 and 1927 they were 2 years old. There were 25 steers in each lot the first year of the experiment and 10 in each lot during the other 2 years. At the beginning of each year's experiment, the steers were divided into two lots as nearly equal as possible in age, size, conformation, and condition.

Each group of steers had access to an open shed about 15 feet wide by 100 feet long with a southern exposure. A 5-acre lot was connected with each shed, which allowed the cattle to remain in the open during nice weather. Water was provided by means of a lake or pond. Block salt was supplied throughout the experiment.

The following feeds were used: Lot 1—Cottonseed meal, blackstrap molasses, and Johnson grass hay. Lot 2—Cottonseed meal and Johnson grass hay.

The hay was lot grade and probably would be classed as No. 2 on the market. It was fed in unlimited amounts but the meal and molasses were restricted to a certain number of pounds daily. Thirty-six percent meal was used. At the beginning of the test the meal and molasses were both fed at the rate of 1 pound daily and increased gradually as the feeding advanced. Steers were fed twice daily.

Table 50. Blackstrap molasses for fattening steers: Alabama, 1926-1928.

	Lot 1	Lot 2
Number steers in lot	15.00	15.00
Average initial weight, lbs.	658.27	648.85
Average final weight, lbs.	826.70	780.50
Average gain per steer, lbs.	168.42	131.64
Average daily gain per steer, lbs.	1.54	1.21
Average daily feed per steer, lbs.:		
Cottonseed meal	4.07	4.07
Molasses	3.85	—
Johnson grass hay	18.40	19.85
Feed per 100 lbs. gain, lbs.:		
Cottonseed meal	266.48	381.90
Molasses	253.24	—
Johnson grass hay	1203.83	1838.51

Reference: Alabama Agricultural Experiment Station Bulletin 231, "Steer Feeding Experiments in the Black Belt of Alabama," pages 4, 5, 6, 7, and 8, tables 1, 2, and 3, Auburn, Alabama, April 1930.

Molasses for Cattle Fed Principally on Roughage

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: 1936-37, November 25, 1936-April 24, 1937 (150 days).

Purpose: To determine the value of cane molasses as a feed for beef cattle when fed principally on roughage.

Procedure and conditions: Two-year-old feeding grade Hereford steers purchased on the Chicago market in November were used in this test. They were fed silage, straw, and hay until started on the experiment November 25, 1936.

The corn and hay fed were a good quality, oats were very heavy, and the cottonseed meal was guaranteed to contain 41 percent protein. The molasses was a cane product; the silage was unusually good and contained more than the normal proportion of ears to the stalk. The wheat straw was very bright.

Table 51. Molasses as a substitute for corn for full-fed cattle.

	Lot 1	Lot 2	Lot 3
	Cottonseed meal silage oat straw salt	Cottonseed meal molasses silage oat straw salt	Cottonseed meal shelled corn silage oat straw salt
Number steers in lot	10.00	10 00	10.00
Average initial weight, lbs.	838.70	843.70	841.70
Average final weight, lbs.	1100.00	1143.00	1138.00
Average gain per steer, lbs.	261.30	299.30	296.30
Average daily gain, lbs.	1.74	2.00	1.98
Feed consumed per 100 lbs. gain, lbs.:			
Shelled corn	—	—	196.05
Supplement	136.24	118.94	120.15
Molasses	—	197.81	—
Silage	2210.95	1792.35	1810.16
Oat straw	38.88	39.16	26.76
Salt	3.06	1.67	2.02
Average daily feed, lbs.:			
Shelled corn	—	—	3.82
Supplement	2.37	2.37	2.37
Molasses	—	3.95	—
Silage	38.58	35.76	35.76
Oat straw	0.68	0.78	0.53
Salt	.053	.033	.040

Reference: Indiana Agricultural Experiment Station Bulletin 430, "Cattle Feeding, 1936-37, Cane Molasses," pages 3 and 7, table 2, Lafayette, Indiana, July 1938.

Methods of Preparing Corn for Yearling Steers

Conducted by: Michigan Agricultural Experiment Station.

Conducted at: East Lansing, Michigan.

Period: November to April, 1932-1935.

Purpose: To compare the feeding values of corn silage, shock corn, and ground or cut corn for finishing yearling steers.

Procedure and conditions: The cattle used in trial 1 were of Hereford

breeding and purchased in Kansas City and averaged 741 pounds when started on the experiment. Those in the second trial were Montana cattle, of Shorthorn breeding, purchased on the Chicago market, and averaged 670 pounds when weighed into the feed lot. The third group of cattle were chiefly of Shorthorn breeding, they were purchased in northern Michigan and weighed 718 pounds. Most of these steers were in the "good" grade, with a few "choice" and a few "medium." Ten steers constituted a lot in each trial, with one exception. In lot 3 during the second trial, one steer died.

The cattle received the following rations:

Lot 1—Ground shock corn, alfalfa hay, cottonseed meal.

Lot 2—Corn silage, alfalfa hay, cottonseed meal.

Lot 3—Shock corn in the bundle, alfalfa hay, cottonseed meal.

The ground shock corn was ground in a roughage mill in semi-weekly quantities as it was fed during the winter. In the first two trials, the feed was put through the cutter and burrs, while in the last trial it was cut but did not pass through the burrs.

The alfalfa hay was fed once daily and the amount regulated by the smallest quantity eaten by any lot of cattle. Approximately 2½ pounds of cottonseed meal per 1000 pounds of liveweight were fed per day in each lot, divided into two feedings. As much corn product was fed in each lot as would be eaten before the next feed.

Table 52. Silage versus shock corn for yearling steers—average 3 Michigan trials, 1932-1935.

Trial 1—155 days Trial 2—154 days Trial 3—165 days	Lot 1	Lot 2	Lot 3
	Ground or cut shock corn	Silage	Shock corn
Total number steers in three trials	30.00	30.00	20.00
Initial weight per steer, lbs.	712.20	711.90	710.40
Final weight per steer, lbs.	986.30	1007.90	967.50
Gain per steer, lbs.	274.00	296.00	257.00
Daily gain, lbs.	1.73	1.87	1.63
Corn acres per steer	.77	.61	.975
Cottonseed meal per steer, lbs.	313.30	310.20	316.30
Alfalfa hay per steer, lbs.	545.50	444.30	589.20

Reference: Michigan Agricultural Experiment Station Bulletin 293, "Methods of Preparing Corn Crop for Yearling Steers," pages 3, 4, 5, and 6, table 1, East Lansing, Michigan, May 1938.

Ground Ear Corn versus Shelled Corn for Beef Cattle

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: 1937-1938.

Purpose: To determine the value of a ration containing ground ear corn and shelled corn.

Procedure and conditions: The cattle used were medium to good 2-year-old Shorthorns and Herefords. They were strong, rugged animals but somewhat lacking in quality. The cattle were purchased in Chicago and upon arrival at Purdue University were fed corn silage and wheat straw until the beginning of the test on November 18.

The corn fed was of high quality; the oat straw was slightly coarse; the

cottonseed meal contained 41 percent protein, and the silage was of unusually good quality due to the fact that the ears on the corn were well developed and the corn had been quite mature before it was harvested.

Table 53. The value of a ration containing ground ear corn and shelled corn: Indiana, 1932-1938.

	Lot 2	Lot 3	Lot 4
	Shelled corn cottonseed meal silage oat straw salt	Ground ear corn cottonseed meal silage, oat straw, salt	Ground ear corn 5-9 shelled corn 4-9 cottonseed meal silage, oat straw, salt
Number steers in lot	10.00	10.00	10.00
Average initial weight, lbs.	856.00	854.30	855.70
Average final weight, lbs.	1170.70	1200.00	1195.30
Average gain per steer, lbs.	314.70	345.70	339.60
Average daily gain, lbs.	2.10	2.30	2.26
Total feed consumed, lbs.:			
Shelled corn	18706.00	—	9458.00
Ground ear corn	—	22855.00	11685.00
Supplement	3369.00	3357.50	3369.00
Silage	27304.00	20732.00	27568.00
Oat straw	1805.00	1703.00	1649.00
Salt	80.00	70.00	100.00
Feed consumed per 100 lbs. gain, lbs.:			
Shelled corn	594.41	—	278.50
Ground ear corn	—	661.12	344.08
Supplement	107.05	97.12	99.20
Silage	867.62	599.71	811.78
Oat straw	57.36	49.26	48.56
Salt	2.54	2.02	2.94
Average daily feed, lbs.:			
Shelled corn	12.47	—	6.31
Ground ear corn	—	15.24	7.79
Supplement	2.25	2.24	2.25
Silage	18.20	13.82	18.38
Oat straw	1.20	1.14	1.10
Salt	.053	.047	.067

Reference: Indiana Agricultural Experiment Station Bulletin 433, "Cattle Feeding, 1937-1938," pages 3 and 4, table 1, Lafayette, Indiana, October 1938.

Steer Fattening Experiments

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1934-1937.

Purpose: To determine the most satisfactory ration for fattening steers.

Procedure and conditions: Steers used in these experiments varied considerably in size and quality but in feeding they were divided into as uniform groups as possible. The different lots were fed as follows:

Lot 1—Grazing on corn and velvet beans in the field.

Lot 2—Dry lot feeding; corn, velvet beans, and peanut hay.

Lot 3—Dry lot feeding; corn, cottonseed meal, and peanut hay.

Lot 4—Dry lot feeding; corn, peanut meal, and peanut hay.

Lot 5—Dry lot feeding; cottonseed hulls and cottonseed meal.

Lot 6—Dry lot feeding; ground snapped corn with cottonseed meal and peanut hay.

Lot 7—Dry lot feeding; ground snapped corn, ground velvet beans, molasses, and peanut hay.

Lot 8—Dry lot feeding; ground snapped corn, ground velvet beans, molasses, and peanut hay.

Lot 9—Dry lot feeding; ground snapped corn, ground velvet beans, and peanut hay.

The steers in lot 1 were placed on corn and velvet beans in the field. Cross fences were used to keep the steers on a comparatively small area which prevented the feed from being wasted. The crop was planted two rows of corn and 1 row of velvet beans.

Dry lot feeding was practiced with all other groups making a comparison of velvet beans, cottonseed meal, and peanut meal. In lot 7, molasses was fed practically pound for pound to corn, and in lot 8, molasses was fed 1 pound molasses to 2 pounds corn as nearly as possible. In these series of tests a comparison is made of ground feed versus whole feed.

All animals in the experiment had a mineral mixture kept before them at all times. The mineral mixture consisted of 33.3 pounds of salt, 33.3 pounds finely ground steamed bonemeal, and 33.3 pounds ground limestone.

Reference: Fifteenth and Seventeenth Annual Reports of the Georgia Coastal Plain Experiment Station, Tifton, Georgia.

Table 54. Results of feeding tests at Georgia Coastal Plain Experiment Station, 1934-1937.

	Grazing		Dry Lot							
	34	35	35	35	35	33	23	11	11	11
Total number steers	Nov. 15*	Nov. 18	Nov. 18	Nov. 18	Nov. 18	Dec. 1	Nov. 13	Jan. 22	Jan. 22	Jan. 22
Date on feed	Mar. 23	Mar. 26	Mar. 26	Mar. 26	Mar. 26	Mar. 21	Mar. 22	May 14	May 14	May 14
Date off feed	129*	129	129	129	129	111	130	112	112	112
Average number days on feed										
Yield per acre:										
Corn, bu.	20.3	—	—	—	—	—	—	—	—	—
Velvet beans, lbs.	412.4	—	—	—	—	—	—	—	—	—
Average feed consumed per steer:										
Corn, lbs.	2709.0	1942.0	2001.0	1973.0	—	—	2179.0	761.0	1047.0	1540.0
Ground corn, lbs.	—	—	—	—	—	—	—	—	—	—
Velvet beans, lbs.	835.0	669.0	—	—	—	—	—	496.0	494.0	496.0
Ground velvet beans, lbs.	—	—	—	—	—	—	—	—	—	—
Peanut meal, lbs.	—	—	329.0	275.8	—	605.76	333.0	—	—	—
Cottonseed meal, lbs.	—	—	—	—	—	—	—	—	—	—
Molasses, lbs.	—	—	—	—	—	2028.26	—	739.0	473.0	0.0
Cottonseed hulls, lbs.	—	—	—	—	—	—	—	—	—	—
Peanut hay, lbs.	—	429.0	525.0	510.6	—	—	521.0	608.0	581.0	443.0
Average daily feed consumed:										
Corn, lbs.	21.00	14.95	15.46	15.20	—	—	—	—	—	—
Ground corn, lbs.	—	—	—	—	—	—	16.80	6.8	9.3	13.8
Velvet beans, lbs.	5.80	5.16	—	—	—	—	—	—	—	—
Ground velvet beans, lbs.	—	—	—	—	—	—	—	4.4	4.4	4.4
Peanut meal, lbs.	—	—	—	2.12	—	—	—	—	—	—
Cottonseed meal, lbs.	—	—	2.56	—	—	5.41	2.55	—	—	—
Molasses, lbs.	—	—	—	—	—	—	—	6.6	4.2	—
Cottonseed hulls, lbs.	—	—	—	—	—	18.18	—	—	—	—
Peanut hay, lbs.	—	3.35	4.06	3.95	—	—	4.05	5.4	5.2	4.0
Average initial weight per steer, lbs.	614.91	614.00	601.00	589.00	—	579.00	634.00	530.0	533.00	553.0
Average final weight per steer, lbs.	818.94	887.00	852.60	827.60	—	772.30	902.0	791.0	813.0	835.0
Total gain per steer, lbs.	304.02	273.00	251.60	238.00	—	192.90	268.00	261.0	280.0	283.0
Average daily gain per steer, lbs.	1.57	2.10	1.93	1.83	—	1.74	2.06	2.33	2.50	2.53
Average number acres grazed per steer:										
Average lbs. beef produced per acre	122.0	—	—	—	—	—	—	—	—	—
Average pounds pork produced	—	517.00	536.00	499.00	—	—	3.25	53.0	53.0	62.0

*Grazing.

PROTEIN SUPPLEMENTS FOR FINISHING CATTLE

Feeds high in protein content are important in finishing beef cattle. The use of protein supplements may have a direct bearing on the economy of gains. A thorough study should be made of the different protein supplements when arriving at a ration to use in finishing beef cattle.

A number of experimental tests have been selected and presented in order that a comparison may be made of the different protein supplements in arriving at a ration to use in finishing mature beef cattle in dry lot.

Cottonseed Meal versus Velvet Bean-and-Pod Meal

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1917-1918.

Purpose: To compare the relative economy of velvet bean-and-pod meal, velvet bean-and-pod meal and corn when fed with silage to beef steers.

Procedure and conditions: The cattle in this trial were good to choice grade beef steers bought locally in the fall of 1916. They were grazed through the summer of 1917, and from frost until being put in the feed lots they had the run of stalk, pea, and velvet bean fields. The breeding of the cattle used in these experiments were Shorthorn, Red Poll, Angus, and Hereford grades.

Table 55. Cottonseed meal versus velvet bean-and-pod-meal, versus varying proportions of broken ear corn and velvet bean-and-pod meal for fattening steers: State College, 1917-1919—140 days.

	1	2	3	4	5
	Cotton- seed meal silage	Velvet bean-and- pod meal, silage	Velvet bean-and- pod meal, light corn ration, silage	Velvet bean-and- pod meal, medium corn ration, silage	Velvet bean-and- pod meal, heavy corn ration, silage
Number of animals	8	8	8	8	8
Initial weight, total, lbs.	8540.33	8058.00	8015.66	7969.66	8125.33
Average initial weight, lbs.	1067.54	1007.25	1001.96	996.21	1015.66
Average final weight, lbs.	1333.04	1229.46	1228.58	1297.08	1308.04
Average gain per steer, lbs.	265.50	222.21	226.62	300.87	292.38
Av. daily gain per steer, lbs. ...	1.90	1.59	1.62	2.15	2.09
Feed consumed per steer, lbs.:					
Cottonseed meal	812.00	—	—	—	—
Velvet bean-and-pod meal....	—	1624.00	1342.75	1064.00	784.00
Broken ear corn	—	—	875.00	1750.00	2625.00
Silage	10943.75	10083.75	7436.25	5360.00	4153.75
Average daily feed per steer, lbs.:					
Cottonseed meal	5.80	—	—	—	—
Velvet bean-and-pod meal ...	—	11.60	9.59	7.60	5.60
Broken ear corn	—	—	6.25	12.50	18.75
Silage	78.17	72.03	53.12	38.29	29.67
Feed required per cwt. of gain, lbs.:					
Cottonseed meal	305.84	—	—	—	—
Velvet bean-and-pod meal .	—	730.85	592.50	353.64	268.15
Broken ear corn	—	—	386.10	581.64	897.82
Silage	4121.94	4537.99	3281.30	1781.47	1420.69

Reference: Mississippi Agricultural Experiment Station Bulletin 222, "Steer Feeding Experiments," pages 6, 7, and 8, table 2, State College, Mississippi, May 1924.

Mixed Protein Supplements Compared to Cottonseed Meal

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: 1937-38.

Purpose: To determine the relative feeding value of different protein mixtures.

Procedure and conditions: The cattle used were medium to good 2-year-old Shorthorns and Herefords. They were strong, rugged animals but somewhat lacking in quality. The cattle were purchased in Chicago and upon arrival at Purdue University were fed corn silage and wheat straw until the beginning of the test on November 18.

The corn fed was of high quality; the oat straw was slightly coarse; the cottonseed meal contained 41 percent protein, and the silage was of unusually good quality due to the fact that the ears on the corn were well developed and the corn had been quite mature before it was harvested.

Table 56. Mixed protein supplements compared to cottonseed meal, Indiana, 1937-1938.

	Shelled corn cottonseed meal, silage oat straw, salt	Shelled corn equal parts cottonseed meal, linseed oil meal, and soybean oil meal, silage oat straw, salt	Shelled corn protein mixture silage oat straw salt	Shelled corn protein mix- ture as in lot 6, minus min- eral, silage oat straw salt
Number steers in lot	10.00	9.00	10.00	10.00
Average initial weight, lbs.	856.00	854.10	855.30	852.00
Average final weight, lbs.	1170.70	1181.40	1181.00	1171.70
Average gain per steer, lbs.	314.70	327.30	325.70	319.70
Average daily gain, lbs.	2.10	2.18	2.17	2.13
Total feed consumed:				
Shelled corn, lbs.	18706.00	16711.00	18513.00	18650.00
Supplement, lbs.	3369.00	3047.00	3369.00	3361.00
Silage, lbs.	27304.00	23635.00	26425.00	27160.00
Oat straw, lbs.	1805.00	1404.00	1301.00	1524.00
Salt, lbs.	80.00	65.00	120.00	60.00
Feed consumed per 100 lbs. gain:				
Shelled corn, lbs.	594.41	567.31	568.41	583.36
Supplement, lbs.	107.05	103.45	103.44	105.13
Silage, lbs.	867.62	802.35	811.33	849.55
Oat straw, lbs.	57.36	47.66	39.94	47.67
Salt, lbs.	2.54	2.20	3.68	1.88
Average daily feed:				
Shelled corn, lbs.	12.47	12.38	12.34	12.43
Supplement, lbs.	2.25	2.26	2.25	2.24
Silage, lbs.	18.20	17.51	17.62	18.11
Oat straw, lbs.	1.20	1.04	0.87	1.01
Salt, lbs.	.053	.048	.080	.040

Reference: Indiana Agricultural Experiment Station Bulletin 433, "Cattle Feeding, 1937-1938," pages 3, 4, and 9, table 3, Lafayette, Indiana, October 1938.

The Value of Cottonseed Meal in a Ration of Shelled Corn, Corn Silage, and Oat Straw

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: 1937-38.

Purpose: To determine the relative feeding value of different protein mixtures.

Procedure and conditions: The cattle used were medium to good 2-year-old Shorthorns and Herefords. They were strong, rugged animals but somewhat lacking in quality. The cattle were purchased in Chicago and upon arrival at Purdue University were fed corn silage and wheat straw until the beginning of the test on November 18.

The corn fed was of high quality; the oat straw was slightly coarse; the cottonseed meal contained 41 percent protein, and the silage was of unusually good quality due to the fact that the ears on the corn were well developed and the corn had been quite mature before it was harvested.

Table 57. The value of cottonseed meal in a ration of shelled corn, corn silage, and oat straw: Indiana, 1937-1938.

	Lot 1	Lot 2
	Shelled corn silage oat straw salt	Shelled corn cottonseed meal silage oat straw salt
Number steers in lot	10.00	10.00
Average initial weight, lbs.	857.00	856.00
Average final weight, lbs.	1108.00	1170.70
Average gain per steer, lbs.	251.30	314.70
Average daily gain, lbs.	1.68	2.10
Total feed consumed, lbs.:		
Shelled corn	18185.00	18706.00
Supplement	—	3369.00
Silage	24841.50	27304.00
Oat straw	1900.00	1805.00
Salt	70.00	80.00
Feed consumed per 100 pounds gain, lbs.:		
Shelled corn	723.64	594.41
Supplement	—	107.05
Silage	988.52	867.62
Oat straw	75.61	57.36
Salt	2.79	2.54
Average daily feed, lbs.:		
Shelled corn	12.12	12.47
Supplement	—	2.25
Silage	16.56	18.20
Oat straw	1.27	1.20
Salt	.047	.053

Reference: Indiana Agricultural Experiment Station Bulletin 433, "Cattle Feeding, 1937-1938," pages 3 and 7, table 2, Lafayette, Indiana, October 1938.

Cottonseed Meal and Peanut Hay for Fattening Steers

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 1937-1939.

Purpose: To determine the value of peanut hay as a roughage for fattening steers and the value of grinding peanut hay for fattening steers.

Procedure and conditions: Thirty head of common to medium feeder steers were used in this test. They were fed in half-acre lots and had access to a shed open to the south. The steers were divided into three uniform lots and fed as follows:

Lot 1—Cottonseed meal, mineral, and sorghum silage.

Lot 2—Cottonseed meal, mineral, and ground peanut hay.

Lot 3—Cottonseed meal, mineral, and unground peanut hay.

The silage fed in lot 1 was made from sorghum cane after most of the heads had been removed. The silage was, therefore, rather low in quality. The peanut hay used varied from year to year but on the average for the 3-year period it was considered to be about medium in quality. All lots of steers received a mineral mixture composed of bonemeal, marble dust, and salt, equal parts, ad libitum.

The results of the test are shown in table 58.

Table 58. Cottonseed meal and peanut hay for fattening steers: Alabama, 1937-1939

	Lot 1	Lot 2	Lot 3
	Cottonseed meal and silage minerals	Cottonseed meal and ground peanut hay minerals	Cottonseed meal and unground peanut hay minerals
Number of steers in lot	10.00	10.00	10.00
Number of days on feed	112.00	112.00	112.00
Initial weight of lot, lbs.	4764.00	4770.00	4775.00
Final weight of lot, lbs.	6185.00	6577.00	6181.00
Total gain of lot, lbs.	1421.00	1807.00	1406.00
Average daily gain per steer, lbs.	1.27	1.61	1.25
Total feed consumed per lot, lbs.:			
Cottonseed meal	5196.00	5196.00	5196.00
Silage	47,063.00	—	—
Peanut hay	—	16489.00	14435.00
Mineral mixture	.86	.86	.83
Feed eaten per 100 lbs. gain, lbs.:			
Cottonseed meal	365.80	287.60	369.80
Silage	3213.00	—	—
Peanut hay	—	813.30	1027.40
Mineral mixture	6.10	4.80	5.90

Reference: Alabama Agricultural Experiment Station Leaflet, "Fattening Steers on Cottonseed Meal and Peanut Hay."

A Comparison of Cottonseed Meal, Cottonseed Meal and Tankage, Peanut Oil Meal, and Soybean Oil Meal, Fed with Corn Silage for Fattening 2-Year-Old Steers

Conducted by: Tennessee Agricultural Experiment Station.

Conducted at: Knoxville, Tennessee.

Period: 1935-36—1937-38.

Purpose: To compare peanut and soybean oil meals with cottonseed meal when each is fed in the same amount with silage for fattening 2-year-old steers.

To compare a mixture of cottonseed meal, 3 parts by weight, and high-grade 60 percent tankage, 1 part by weight, with cottonseed meal, when each is fed in the same amount with silage for fattening 2-year-old steers.

Procedure and conditions: Four lots, each consisting of 7 steers, occupied a stall approximately 24 by 14 feet. Fresh water was available at all times. The cattle were kept in the stall for the entire feeding period, except on weighing days, when they were out for a few minutes. This was done to conserve all the manure and to facilitate gains.

The native steers used in the experiment showed a predominance of Angus, Hereford, or Shorthorn breeding. Some showed their breed characteristics to a marked degree, but most of them were grades or crosses. They were 2-year-old cattle, grading medium to choice as feeders.

The following rations were fed, each day's ration divided into two equal parts, one fed in the morning and the other at night:

Lot 1—Silage and cottonseed meal.

Lot 2—Silage and a mixture of 3 parts by weight of cottonseed meal, and 1 part by weight of high-grade 60 percent tankage.

Lot 3—Silage and soybean oil meal.

Lot 4—Silage and soybean oil meal.

The amount of silage fed was the same for each lot, being governed by the lot consuming the least. The silage contained only a reasonable number of ears of corn.

The concentrates were fed as follows:

3 pounds per head per day the first month.

4 pounds per head per day the second month.

5 pounds per head per day the third month.

6 pounds per head per day the fourth month.

7 pounds per head per day the last 20 days.

Table 59. Protein concentrates for fattening 2-year-old steers: Tennessee: 1935-36—1937-38.

	Lot 1	Lot 2	Lot 3	Lot 4
Average number steers per lot	7	7	7	7
Average number days in experiment	140	140	140	140
Average initial weight, lbs.	873.7	871.9	871.2	875.2
Average weight at end of 140 days, lbs.	1126.1	1125.1	1114.1	1130.3
Average gain per steer, lbs.	252.4	253.2	242.9	255.1
Average daily gain per steer, lbs.	1.800	1.808	1.735	1.822
Average daily ration for 140-day period, lbs.				
Silage	44.7	44.7	44.5	44.7
Cottonseed meal	4.86	—	—	—
Cottonseed meal 3 parts; tankage 1 part	—	4.86	—	—
Peanut oil meal	—	—	4.86	—
Soybean oil meal	—	—	—	4.86
Salt	.076	.090	.085	.064

Reference: Tennessee Agricultural Experiment Station Bulletin 167, "A Comparison of Cottonseed Meal, Cottonseed Meal and Tankage, Peanut Oil Meal, and Soybean Oil Meal, Fed with Corn Silage for Fattening Two-Year-Old Steers," pages 4, 5, and 6, tables 3 and 5, Knoxville, Tennessee, October 1938.

The Value of Tankage for Fattening Beef Calves

Conducted by: South Dakota Agricultural Experiment Station.

Conducted at: Brookings, South Dakota.

Period: Three years, beginning April 4, 1935 and ending October 15, 1938.

Purpose: To determine the value of tankage as a protein supplement for fattening cattle.

Procedure and conditions: The 85 calves used during the 3 different years were grade Herefords purchased in Hand County, South Dakota. Each year they were selected to insure uniformity as to conformation, age, size, and weight. On arrival at the station they were taught to eat grain before being weighed up on 3 successive days for the experiment. However, for the first trial the calves were used in a Russian Thistle experiment before being put in the tankage experiment. They were relotted when started on tankage experiment so that each new lot included one calf from each of the five lots in the thistle experiment.

The following feeds were used:

Lot 1—Shelled corn and alfalfa hay.

Lot 2—Shelled corn, alfalfa hay, and linseed oil.

Lot 3—Shelled corn, alfalfa hay, and cottonseed meal.

Lot 4—Shelled corn, alfalfa hay, and dry-rendered tankage.

Lot 5—Shelled corn, alfalfa hay, and a mixture of linseed oil meal and tankage, half and half by weight.

Lot 6—Shelled corn, wild hay, and tankage.

The feeds used were all purchased in the local market. They were weighed out both morning and evening and each lot given what it would clean up. In each case the protein supplement was mixed with the shelled corn. Pigs were put in yards to clean up the waste.

Table 60. Tankage as a protein supplement for fattening beef calves: South Dakota, 1935-1938.

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Average initial weight per calf, lbs. ...	475.5	477.5	475.7	475.1	476.2
Average final weight per calf, lbs. ...	1031.8	1070.5	1074.3	1028.7	1064.6
Total gain per calf, lbs.	556.3	593.0	598.4	553.6	588.4
Average daily gain per calf, lbs.	2.23	2.37	2.39	2.21	2.35
Feed consumed for 100 lbs. gain, lbs.:					
Shelled corn	632.87	592.85	598.99	623.2	632.74
Linseed oil meal	—	42.08	—	—	15.73
Cottonseed meal	—	—	41.63	—	—
Tankage	—	—	—	22.13	15.73
Alfalfa hay	275.92	239.40	253.02	276.80	231.66

Reference: South Dakota Agricultural Experiment Station Bulletin 329, "Tankage a Protein Supplement for Beef Calves," pages 5 and 13, table 3, Brookings, South Dakota, June 1939.

The Value of Cottonseed Meal and Soybeans for Fattening Cattle

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: 1932-1936.

Purpose: To compare cottonseed meal and soybeans for fattening cattle.

Procedure and conditions: The cattle used in the test were western calves. In 1932-33 they were Hereford calves raised in Texas; in 1933-34 the calves were choice Hereford calves, reported to have been raised near Wichita Falls, Texas. In 1935-36 Herefords were purchased direct from the range.

The corn fed in these trials was grown locally, and in most instances graded

numbers 3 and 4. It was hauled from the elevator when needed and some loads were not as good as others. However, all lots of cattle received the same grade of corn.

The hay was of good quality at all times. However, it contained a very small percentage of timothy.

The cottonseed meal was choice grade, containing 41 percent protein. The silage was made from well-matured corn.

Table 61. The relative value of cottonseed meal or soybeans for fattening cattle: Indiana, 1932-1936.

Average of three experiments			
	Shelled corn silage clover hay salt	Shelled corn whole soybeans silage, clover hay, salt	Shelled corn cottonseed meal silage, clover hay, salt
Number steers in lot	14	15	15
Average initial weight, lbs.	477.3	476.8	477.2
Average final weight, lbs.	939.7	978.7	1032.7
Average gain per steer, lbs.	462.4	501.9	555.5
Average daily gain, lbs.	1.78	1.91	2.11
Feed consumed per 100 lbs. gain, lbs.:			
Shelled corn	626.15	459.69	466.62
Supplement	—	79.56	72.22
Silage	509.89	494.24	483.74
Clover	163.31	148.38	137.53
Salt	2.99	2.53	2.25
Average daily feed, lbs.:			
Shelled corn	10.78	8.72	9.74
Supplement	—	1.50	1.51
Silage	9.03	9.46	10.19
Clover hay	2.82	2.77	2.86
Salt	.054	.051	.033

Reference: Indiana Agricultural Experiment Station Bulletin 429, "Cattle Feeding, 1932-33, 1933-34, 1935-36," pages 3, 4, and 5, table 1, Lafayette, Indiana, July 1938.

Meat Meal Tankage as a Feed for Beef Cattle

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: 1934-35.

Purpose: To determine the value of tankage as a feed for beef cattle.

Procedure and conditions: In this test, tankage has been compared to cottonseed meal with three different feed combinations. The trial was conducted with a medium grade of steers shipped from the St. Paul, Minnesota market. Hereford blood predominated, but Shorthorn breeding was strongly evidenced.

The feeds used were above average in quality. The roughage, especially, seemed to be of high feeding value. The meat meal tankage was 65 percent protein and the cottonseed meal contained 41 percent protein.

Table 62. Meat meal tankage as a feed for beef cattle: Indiana, 1934-35

	Tankage and cottonseed meal for cattle receiving silage and hay		Tankage vs. cottonseed meal for full-fed cattle		Tankage for cattle receiving silage and oat straw		
	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7
	Tankage silage clover hay	Cottonseed meal silage clover hay	Shelled corn tankage silage clover	Shelled corn cottonseed meal silage clover hay	Tankage silage straw	Cottonseed meal silage	Soybeans silage straw
Number steers in lot	10	10	10	10	10	10	10
Average initial weight, lbs.	824.5	825.5	825.5	822.5	821.5	821.5	822.0
Average final weight, lbs.	1122.7	1135.2	1197.0	1189.7	1094.3	1066.0	1108.7
Average gain per steer, lbs.	298.2	309.7	371.5	367.2	272.8	244.5	286.7
Average daily gain, lbs.	2.13	2.21	2.65	2.62	1.95	1.75	2.05
Feed consumed per 100 lbs. gain, lbs.:							
Shelled corn	—	—	472.68	478.21	—	—	—
Supplement	84.24	98.38	68.69	83.22	92.08	124.99	106.59
Silage	2004.02	1932.43	1061.40	1073.80	2203.81	2458.90	2096.97
Hay	198.12	231.70	137.71	137.99	133.32	169.08	147.75
Average daily feed, lbs.:							
Shelled corn	—	—	12.54	12.54	—	—	—
Supplement	1.79	2.18	1.82	2.18	1.79	2.18	2.18
Silage	42.69	42.75	28.17	28.16	42.94	42.94	42.94
Hay	4.22	5.13	3.65	3.62	2.60	2.95	3.03

Reference: Indiana Agricultural Experiment Station Bulletin 428, "Cattle Feeding, 1934-35, Meat Meal Tankage," pages 3, 5, 6, and 7, tables 1, 2, and 3, Lafayette, Indiana, July 1938.

Roughages for Finishing Beef Cattle

Beef cattle finished in dry lot require a considerable amount of bulky feeds, which are supplied by roughage such as hay, silage, cottonseed hulls, etc. These feeds are usually relatively cheap; therefore, the finishing ration should contain a maximum amount of such feeds. The success of finishing mature cattle in dry lot may depend largely on how well the maximum amount of cheap feeds is used.

A number of experiments comparing different roughages have been selected and presented in this section to be used in determining the best roughage to use in finishing mature beef cattle in dry lot.

Varying Amounts of Cottonseed Hulls and Sorghum Silage for Finishing Mature Steers

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 106 days, December 11, 1930 to March 26, 1931.

99 days, October 22, 1931 to January 29, 1932.

120 days, October 26, 1932 to February 22, 1933.

Purpose: To compare the feeding value of cottonseed hulls and sorghum silage when fed in varying mixtures of sorghum silage and cottonseed hulls for fattening mature steers, the cottonseed meal and Johnson grass hay to be fed in constant amounts.

Procedure and conditions: The steers used in the three trials were of Jersey breeding, commonly termed "yellow hammers" and were 2 years old or older. All animals used were dehorned. The animals were divided as nearly as possible with reference to quality, weight, and condition into four equal lots.

The following feeds were fed:

- Lot 1: Cottonseed meal, 5 to 7 pounds
Sorghum silage, ad libitum
Johnson grass hay, 3 pounds
- Lot 2: Cottonseed meal, 5 to 7 pounds
 $\frac{3}{4}$ sorghum silage, $\frac{1}{4}$ cottonseed hulls, ad libitum
Johnson grass hay, 3 pounds
- Lot 3: Cottonseed meal, 5 to 7 pounds
 $\frac{1}{2}$ sorghum silage, $\frac{1}{2}$ cottonseed hulls, ad libitum
Johnson grass hay, 3 pounds
- Lot 4: Cottonseed meal, 5 to 7 pounds
Cottonseed hulls, ad libitum
Johnson grass hay, 3 pounds

The animals were fed daily at 7 a.m. and 5 p.m. on all feeds except hay, which was fed at the evening feed. The silage and hulls and combinations of silage and hulls were fed ad libitum, and the hay was limited to 3 pounds per steer. Two pounds of cottonseed meal per steer were fed for the first 4 days. The meal was increased one pound each 4 days until 6 pounds were being fed. This amount was fed during the first 60 days of the test. Seven pounds were fed during the next 30 days and 8 pounds were fed during the remainder of the test. The cottonseed meal was thoroughly mixed with the silage and hulls and silage and hulls mixture. Adjustments were made on a dry weight basis in mixing the cottonseed hulls and sorghum silage, 3 pounds of silage being allowed for each pound of cottonseed hulls fed. In lot 2 the

ratio was 1 pound of cottonseed hulls to each pound of silage and in lot 3 the ratio was 1 pound of cottonseed hulls to 3 pounds silage.

Fresh water was supplied to each lot in concrete troughs and block salt was available at all times.

The four lots received as nearly the same treatment as was possible during the experimental feeding period. Each lot was fed under a shed 30 feet long and 16 feet wide. The shed opened into lots approximately $1/7$ acre in size. The lots became very muddy during rainy weather, but the stalls were bedded with oat straw as often as it was necessary to keep them dry.

The cottonseed hulls used in this test were of good quality and were free from foreign material. The sorghum silage and Johnson grass hay used were grown on the experiment station farm. The silage in all cases was made from sorghum that had well matured seed and was of good quality, having a pleasant odor and a bright color. The Johnson grass hay would have graded barely No. 1.

Table 63. Varying amounts of cottonseed hulls and sorghum silage for finishing mature steers: Mississippi, 1931-1933.

	Lot 1	Lot 2	Lot 3	Lot 4
Average initial weight, lbs.	874.4	879.0	872.7	875.3
Average final weight, lbs.	1036.7	1058.3	1051.3	1041.0
Average gain per steer, lbs.	162.3	179.3	178.6	165.7
Average daily gain, lbs.	1.50	1.65	1.65	1.53
Average daily rations, lbs.:				
Cottonseed meal	5.93	5.93	5.93	5.93
Cottonseed hulls	—	6.45	14.22	31.10
Sorghum silage	67.08	58.04	42.45	—
Johnson grass hay	3.00	3.00	3.00	3.00
Feed required per 100 pounds gain, lbs.:				
Cottonseed meal	414.00	365.00	364.50	392.30
Cottonseed hulls	—	392.10	859.00	2061.00
Sorghum silage	4493.20	3528.80	2577.20	—
Johnson grass hay	207.1	183.30	183.10	197.70
Shrink percent	7.34	6.70	6.93	6.99
Dressing percent (market wt.)	56.78	56.21	57.24	57.39

Reference: Mississippi Agricultural Experiment Station Bulletin 301, "Varying Amounts of Cottonseed Hulls and Sorghum Silage for Finishing Mature Steers," pages 1, 2, and 7, table 6, State College, Mississippi, November 1933.

Comparison of Roughages for Finishing Steers

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 93 days, December 22, 1926 to March 25, 1927.

120 days, December 8, 1927, to April 6, 1928.

120 days, November 26, 1929 to March 26, 1930.

Purpose: To find the most economical ration combination consisting of cottonseed meal and roughages for the finishing of common mature steers, also to compare the yield and production costs of those silage crops best suited to Mississippi conditions.

Procedure and conditions: Native grade Jersey or "yellow hammer" steers were used in all the experiments with the exception of the first year when

there were two grade steers in each lot. The animals were 2 years old or over and were divided as nearly as possible into equal lots according to size, type, and breeding.

All lots were fed twice each day and the times of feeding, 6:30 a.m. and 4:30 p.m., were as regular as possible. The rations by lots were as follows:

Lot 1—Cottonseed meal 6.5 pounds

Corn silage ad libitum

Johnson grass hay 3 pounds

Lot 2—Cottonseed meal 6.5 pounds

Cottonseed hulls ad libitum.

Johnson grass hay 3 pounds

Lot 3—Cottonseed meal 6.5 pounds

Sorghum silage ad libitum

Johnson grass hay 3 pounds

Lot 4—Cottonseed meal 6.5 pounds

Sagrain silage ad libitum

Johnson grass hay 3 pounds

A fifth lot was added at the beginning of the second experiment and was fed as follows:

Lot 5—Cottonseed meal 6.5 pounds

Johnson grass hay ad libitum

The cottonseed meal in the last two tests was fed in the beginning at the rate of 2 pounds per head daily. This amount was increased 1 pound each fourth day until 6 pounds were being fed. This amount was continued through the first 60 days of the test. Seven pounds were fed for the next 30 days and 8 pounds were fed during the last 30 days of the test.

Fresh hydrant water and block salt were available at all times.

Table 64. Roughages for finishing steers: average of three tests: Mississippi 1927-1930

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Number steers per lot	8.6	8.6	8.6	8.6	8.0
Average initial weight, lbs.	803.94	802.65	801.77	800.88	801.96
Average final weight, lbs.	1022.40	1010.70	991.83	988.51	977.88
Average daily gain, lbs.	1.85	1.87	1.72	1.68	1.46
Average daily feed for steers, lbs.:					
Cottonseed meal	6.44	6.44	6.44	6.44	6.48
Silage	48.44	—	50.92	47.42	—
Cottonseed hulls	—	23.50	—	—	—
Johnson grass hay	3.00	3.00	3.00	3.00	—
Feed required per 100 lbs. gain, lbs.:					
Cottonseed meal	326.91	510.60	378.76	382.60	452.23
Silage	2452.63	—	2934.25	2824.37	—
Cottonseed hulls	—	1255.98	—	—	—
Johnson grass hay	152.86	1615.40	177.90	179.77	1076.00

Reference: Mississippi Agricultural Experiment Station Bulletin 279, "Comparison of Roughages for Finishing Steers," pages 2, 3, 8, 10, and 11, tables 3, 4, and 5, State College, Mississippi, July 1930.

A Comparison of Sorghum Silage, Peanut Hay, and Cottonseed Hulls As Roughage for Fattening Steers

Conducted by: Florida Agricultural Experiment Station.

Conducted at: North Florida Experiment Station at Quincy, Florida.

Period: 1934-1937.

Purpose: To determine the feeding value of sorghum silage, peanut hay, and cottonseed hulls.

Procedure and conditions: At the beginning of each test the steers, mostly long yearlings, were divided as uniformly as possible according to age, weight, and grade as feeder steers. At the close of the feeding period they were graded and slaughtered. The dressing percent of each lot was obtained. In addition to the roughages, a uniform grain mixture of broken ear corn (snapped corn), velvet beans in the pod, and cottonseed meal was used as concentrates. During the second and third years an additional lot of steers was added in which peanut meal replaced cottonseed meal in the concentrates of the ration, sorghum silage being used as roughage. The sorghum silage was made from Texas Seed Ribbon cane, being cut when the interior of the seeds was in the dough stage. The peanuts used were of a fair quality. Cottonseed hulls were purchased on the local market. A good grade of hulls was obtained each year. The cottonseed meal contained 41 percent protein. Since numerous inquiries had been received as to whether peanut meal could be substituted for cottonseed meal in a ration for steers, it was decided to add one lot of steers during the second and third years of the experiment to ob-

Table 65. A comparison of roughages for fattening steers: Florida, 1935-1939.

	1935	1936	1937	Average*
	lbs.	lbs.	lbs.	lbs.
Lot 1				
Average daily ration:				
Sorghum silage	19.14	15.77	20.01	18.45
Broken ear corn	7.80	8.01	9.01	8.28
Velvet beans in pod	2.92	2.49	1.62	2.32
Cottonseed meal	2.30	2.56	2.94	2.60
Total gain for lot	2560.00	2263.00	2555.00	2459.30
Average daily gain	1.73	1.89	1.83	1.81
Lot 2				
Average daily ration:				
Peanut hay	6.26	6.11	5.14	5.96
Broken ear corn	7.80	8.61	9.01	8.45
Velvet beans in pod	2.92	2.61	1.62	2.38
Cottonseed meal	2.30	2.76	2.94	2.65
Total gain for lot	2857.00	2293.00	2137.00	2429.00
Average daily gain	1.93	1.91	1.53	1.79
Lot 3				
Average daily ration:				
Cottonseed hulls	9.00	10.32	10.41	9.87
Broken ear corn	7.80	8.57	9.01	8.44
Velvet beans in pod	2.92	2.61	1.62	2.38
Cottonseed meal	2.30	2.76	2.94	2.65
Total gain for lot	2873.00	2575.00	2563.00	2670.30
Average daily gain	1.94	2.15	1.83	1.96
Lot 4				
Average daily ration:				
Sorghum silage	—	17.24	18.46	17.90
Broken ear corn	—	8.61	9.01	8.82
Velvet beans in pod	—	2.61	1.62	2.08
Peanut meal	—	2.76	2.94	2.86
Total gain for lot	—	2235.00	2523.00	2379.00
Average daily gain	—	1.86	1.80	1.83

*Weighted.

tain information on this point. The peanut meal was the highest grade produced, free from hulls, and contained 45 percent protein. The animals were given all the roughage they would eat. The grain allowance was increased as the animals indicated they would consume more grain and still eat a sufficient amount of roughage so that definite comparisons could be made of the roughage. As the feeding period progressed and the steers gained weight, the grain allowance was raised slightly.

A mineral mixture of steamed bonemeal, common salt, and the "saltsick" lick were kept before the steers at all times. The "saltsick" lick consisted of the following ingredients:

Common salt, 100 pounds.

Red oxide of iron, 25 pounds.

Copper sulfate, 25 pounds.

These ingredients were mixed thoroughly and the mixture placed in one compartment of a mineral box. The steamed bonemeal and common salt were placed in adjoining compartments.

Reference: Florida Agricultural Experiment Station Bulletin 320, "A Comparison of Sorghum, Peanut Hay, and Cottonseed Hulls as Roughages for Fattening Steers," pages 3, 4, 5, and 6, table 4, Gainesville, Florida, June 1938.

PASTURES AND TEMPORARY GRAZING CROPS

The success or failure of a general beef cattle production program is closely associated with available pasture. Livestock producers often state that pastures are a prerequisite to success in beef cattle production. The success of beef cattle production depends to some extent on the cattle utilizing cheap feeds that require very little labor and expense to produce. Pasture seems to be the cheapest or best source of such feed. The climatic conditions in Mississippi are such that permanent pastures afford grazing for cattle from 7 to 8 months of the year. This being true, it seems important that beef cattle producers should put forth considerable effort to see that sufficient pasture is available for cattle.

The pasture for cattle may be divided into summer and winter periods. Pastures during the summer period are usually much easier to supply and in some instances producers have an abundance of grazing on pastures during the spring and early summer months, but a shortage during the dry period in late summer and early fall. The grass available during the spring and early summer months will carry a much larger number of cattle than the grass available during late summer and early fall. If the grass is to be fully utilized during the spring and early summer months, the producer has two alternatives (1) keep enough cattle on pasture to consume the available grass and marketing some of the cattle from the pasture when the grass supply begins to diminish; or (2) supplement pasture during the critical grazing period with supplementary summer grazing crops such as kudzu, millet, soybeans, and lespedeza. Experimental tests have been conducted to show how much gain a producer may expect from temporary grazing crops. The possibility of supplying temporary grazing crops should be considered in planning a beef cattle production program.

The winter period appears to bring about one of the most critical problems that beef cattle producers face. Careful planning for this period is necessary if producers are to winter cattle economically and in addition maintain the cattle in thrifty condition. Experimental tests are available that show the value of temporary winter grazing crops as well as tests on other means of winter cattle. The principal feeds used are roughages. The tests on temporary grazing crops and wintering tests should be helpful in planning a future feeding program for beef cattle.

It does not seem possible to over-emphasize the importance of permanent pasture in a beef cattle production program. With the success of a beef cattle production program depending so much on pasture it seems that considerable effort should be made to improve the quality of pastures. Much has been said about ways and means of pasture improvement. Many of the suggested ways of pasture improvement require considerable time and labor as well as capital. There are thousand of acres of so-called pasture land in Mississippi that afford but little grazing due to the competition of brush and weeds as illustrated in figure 9. Removing brush and controlling weeds seems to be one of the most important and first improvements that should be made on Mississippi pastures. After the brush has been removed, the sprouts and weeds can be controlled satisfactorily by mowing. If mowing is practiced at least twice each year the producer can be fairly certain of having fair to good



Figure 9. Brush land is often desirable for the establishment of permanent pasture. The above picture shows cleared and uncleared brush land.



Figure 10. First year cleared brush land mowed one time (left) and unmowed (right).



Figure 11. First year pasture that has been mowed one time during the grazing season.



Figure 12. Pasture that has been cleared 2 years and mowed two times each grazing season.

grazing the first year and brush and weeds under control after two or three seasons.

Pastures handled in this manner are known to furnish very satisfactory grazing, and desirable grasses begin to appear without seeding. This type of pasture improvement has been practiced by the Mississippi Experiment Station with very satisfactory results. The results of this type of pasture improvement are illustrated in figures 10, 11, and 12. Other improvement practices include soil preparation, seeding, sodding, fertilization, and controlled grazing.

Experimental information is presented in this section on permanent pasture improvement, temporary summer and winter grazing, and wintering beef cattle. This information seems applicable for use in considering the management of the breeding herd and the production of calves, the production of 2-year-old cattle, the production of cattle over 2 years old, and the finishing of cattle on pasture and grain. It is suggested that experimental information in this section should be considered in setting up a production program for the different phases of beef cattle business listed above.

Table 66. Effect of lime and phosphate on white dutch clover: Holly Springs, 1941

Pounds 16 percent super-phosphate per acre	Green weight per acre with	
	1000 lbs. dolomite	No lime
None	3472.7	4094.6
100	10149.5	8899.3
200	19196.5	12131.5
300	15173.8	14331.2

Reference: Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," page 16, table 6, July 1941, State College, Mississippi.

Table 67. Effect of phosphating on the yield of low hop clover: West Point, 1938.

Treatment	Green weight per acre	Dry weight per acre
None	3726.8	1016.3
200 lbs. 20 percent superphosphate	9583.2	2371.8
400 lbs. 20 percent superphosphate	13213.2	3049.6
800 lbs. 20 percent superphosphate	13745.6	3019.9

Reference: Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," page 18, table 9, July 1941, State College, Mississippi.

Table 68. Alyce clover fertilization: Holly Springs, 1940.

Fertilization	Pounds dry weight per acre
None	3947.0
200 lbs. 20 percent superphosphate	4351.8
200 lbs. superphosphate plus 50 lbs. muriate of potash	5566.2

Reference: Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," page 22, table 12, July 1941, State College, Mississippi.

Table 69. Influence of fertilization on the yield and grazing of top-dressed pastures on Grenada soil: Holly Springs, 1937-1940.

Fertilizer treatment	Pounds dry matter per acre av.	Percent of growth not grazed
	1937-1940	
L—Lime 4000 lbs. (applied 1937)	2904.0	32.16
P—400 lbs. superphosphate (20 percent)	6193.6	6.44
N—250 lbs. nitrate of soda (16 percent)	3891.3	40.12
K—80 lbs. muriate of potash (50 percent)	3742.8	22.43
LP*	5237.0	5.64
LK*	4006.0	18.27
LN*	4858.7	30.09
LPK*	4561.5	15.80
LPKN*	5542.6	25.13
None	3236.3	23.91

*Combination of lime, phosphorus, nitrogen, and potash in quantities listed in first four lines of table.

Reference: Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," page 28, table 15, July 1941, State College, Mississippi.

Table 70. The effect of a single application and of four annual applications of superphosphate: Holly Springs, 1937-1940.

Treatment	Pounds dry matter per acre			
	1937	1938	1939	1940
Check	1763.3	3912.3	3578.2	3691.2
400 lbs. superphosphate in 1937	3097.3	6324.9	4399.8	4495.2
400 lbs. superphosphate annually	3097.3	8787.2	5769.3	7120.5
Percent increases over check				
400 lbs. superphosphate in 1937	75.7	61.6	23.0	21.8
400 lbs. superphosphate annually	75.7	124.6	61.2	92.9

Reference: Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," page 28, table 16, July 1941, State College, Mississippi.

Table 71. Effect of different fertilizer analyses on pasture yields: Holly Springs.

Analyses 400 lbs. per acre	Pounds dry matter per acre	
	Limed	Not limed
0-0-4	4493.2	3470.2
0-4-0	4680.1	4611.7
8-0-0	3845.0	3733.3
0-8-4	6016.2	5870.9
4-8-4	5259.7	5818.4
0-8-8	5858.0	5750.3
6-8-4	5656.7	5458.7
8-4-4	5264.9	4329.0
8-12-4	6656.1	5688.6
8-0-4	3862.8	3410.9
8-8-0	5938.4	5770.9
0-12-0	6841.4	6367.6
0-8-0	6279.1	5613.0
0-0-8	3636.2	3803.4
8-8-8	6574.2	5868.1
0-0-0	4287.2	3857.4

Reference: Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," page 30, table 18, July 1941, State College, Mississippi.

Table 72. Effect of top-dressing with varying amount of lime on Norfolk very fine sand: Pearl River County, 1940.

Pounds applied per acre			Yield
Dolomite	plus	Superphosphate	Pounds dry weight per acre
80	plus	200	2095.7
160	plus	200	2273.4
240	plus	200	2517.8
320	plus	200	2605.5
480	plus	200	4124.7
960	plus	200	3554.5
No treatment			1399.6

Reference: Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," page 31, table 19, July 1941, State College, Mississippi.

Fertilizing Pasture Grazing Experiment

Conducted by: Kentucky Agricultural Experiment Station.

Conducted at: Western Kentucky Agricultural Experiment Station, located 1½ miles east of Princeton.

Period: 1929-1940.

Soil: Sandstone tract of substation.

Purpose: To compare the benefits of fertilizer for pasture improvements.

Procedure and conditions: This test covers a 30-acre tract of land. The area is quite rolling and was badly eroded and gullied. When the land was purchased the vegetation consisted mostly of bush and saw briars, bottom weed, and poverty grass.

The area was bushed and grubbed and the gullies plowed in. The land was terraced in the summer of 1927 and was then divided into three fields. Field 1 was left untreated, field 2 was treated with 1200 pounds of raw rock phosphate per acre, and field 3 was treated with 1½ tons of ground limestone and 1600 pounds of 16 percent superphosphate. In August 1927 all three fields were seeded to rye grass, and in the spring of 1928 the fields were disked and sowed to the following grasses:

	Pounds per acre		Pounds per acre
Orchard grass	6	White clover	1
Redtop	2/3	Sweet clover	2
Canada bluegrass	2	Common lespedeza	1 2/3
Kentucky bluegrass	2	Korean lespedeza	1 2/3

Pasture experiments using yearling steers were started in 1929.

In 1934 and again in 1939, field 3 was top-dressed with superphosphate and field 2 with rock phosphate. Field 3 received an additional ton of limestone per acre in 1935. The two phosphate fertilizers were used in such rates that the cost per acre was the same. The results of the grazing trials are shown in table 73.

Table 73. Average gains made by yearling steers grazing on legume-and-grass mixtures on three 10-acre fields: Kentucky, 1929-40.

Field No.	Treatment	Average number of steers per acre	Average yearly gain per field	Average cost per pound of gain
			lbs.	cents
1	None	2.6	461	10.5
2	Rock phosphate	6.4	1640	3.1
3	Limestone and superphosphate....	6.7	1605	3.2

Reference: Kentucky Agricultural Experiment Station Circular 52, "Grass Farming for Improving Depleted Soils," pages 14 and 15, March 1942, Lexington, Kentucky.

Beef Production per Acre on Pasture When Different Fertilizer Treatments Were Used

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1931-1939.

Purpose: To compare the production of beef per acre on different fertilizer treatments.

Procedure and conditions: This experiment was designed for lowland permanent pasture and was conducted on wet, branch bottom land typical of the Coastal Plain area. The land originally was swampy and scattered with timber, briars, and bushes. The land was cleared, stumped, and drained, with a central open ditch with lateral ditches, where necessary, to cut off hill seepage.

The plants used on the improved plots consisted of carpet grass, dallis grass, common lespedeza, and white clover. The lowland permanent pasture experiment included fertilizer tests. Superphosphate, potash and one-half the nitrogen were applied about the middle of March. The remaining half of nitrogen was applied as a top-dressing about July 20. From the beginning of the test in 1931 through 1935, nitrogen was applied each year while superphosphate and potash were applied at 3-year intervals.

Good grade yearling Hereford steers were used throughout the experiment. No supplemental feed was given while on pasture. A mixture of equal parts of marble dust (calcium carbonate), steamed bonemeal, and salt was kept before the steers at all times. The steers were weighed at regular 4-week intervals. The results of this test are shown in table 74.

Table 74. Lowland permanent pasture fertilizer test: Tifton, Georgia, 1931-1939

Pasture and fertilizer combination	Average no. steers grazed	Average initial weight	Average final weight	Average gain per steer	Average liveweight per acre
		lbs.	lbs.	lbs.	lbs.
6 acres, carpet grass No fertilizer	4.9	462	553	91	74
6 acres, mixture* 600 lbs. 6-0-0 fertilizer** per acre	5.97	464	608	144	147
3½ acres, mixture* 600 lb. 0-0-6 fertilizer** per acre	3.67	462	614	152	154
6 acres, mixture* 600 lbs. 6-12-0 fertilizer** per acre	8.35	463	671	208	288
6 acres, mixture* 600 lbs. 6-12-6 fertilizer** per acre	8.37	473	698	225	318

*Pasture mixture consists of carpet grass, dallis grass, common lespedeza, and white clover.

**Nitrogen, phosphoric acid, and potash in the order named.

NOTE: Results for 1935 on 6 acres of carpet grass without fertilizer not included.

Reference: Georgia Coastal Plain Experiment Station Twentieth Annual Report, 1939-40, pages 39, 40, and 42, table 26, Tifton, Georgia, July 1940.

Annual Summer Pasture for Beef Production

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1935-1939.

Purpose: To compare annual summer crops for beef production.

Procedure and conditions: In this test summer and winter temporary pastures were grown in rotation on the same land, giving two crops per year. The rotation is arranged as nearly as possible where a legume follows a non-legume crop. No fertilizer was used on any of the crops. All the summer crops were planted in rows and cultivated with the exception of common lespedeza which is sown broadcast on young oats.

Good grade yearling Hereford steers and heifers were used in this test. A mineral mixture was kept before the animals at all times. The results of this 5-year test are shown in table 75.

Table 75. Annual summer pastures: Tifton, Georgia, 1935-1939.

	Pasture			
	Cattail millet	Otootan soybeans	Common lespedeza	Velvet beans*
Av. number acres grazed	6.0	6.0	6.9	6.0
Av. number animals grazed	8.3	7.5	6.1	6.4
Av. initial weight, lbs.	492.0	510.0	504.0	611.0
Av. final weight, lbs.	583.0	579.0	610.0	645.0
Av. gain per animal, lbs.	91.0	69.0	106.0	34.0
Av. liveweight gain per acre, lbs.	141.0	102.0	92.0	41.0

*Three-year average.

Reference: Georgia Coastal Plain Experiment Station Twentieth Annual Report, 1939-40, pages 43 and 44, table 28, Tifton, Georgia, July 1940.

Kudzu as a Grazing Crop for Beef Cattle

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1933-1939.

Purpose: To determine the possibility of kudzu as a summer pasture for beef production.

Procedure and conditions: In this test kudzu was planted and cultivated well the first year and a good stand was established before grazing was started the third year after planting. Good grade yearling Hereford steers were used in this test. The animals were weighed every 4 weeks. A mineral mixture was kept before the steers at all times. The results of this test are shown in table 76.

Table 76. Kudzu as a grazing crop for beef cattle: Tifton, Georgia, 1933-1939.

	3-acre kudzu pasture
Average number steers grazed	3.2
Average initial weight, lbs.	488.0
Average final weight, lbs.	726.0
Average gain per steer, lbs.	238.0
Average liveweight gain per acre, lbs.	245.0

Reference: Georgia Coastal Plain Experiment Station Twentieth Annual Report, 1939-40, pages 46 and 47, table 32, Tifton, Georgia, July 1940.

Annual Winter Pasture for Beef Production

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: Winter 1939 and 1940.

Purpose: To compare different winter grazing crops for beef production.

Procedure and conditions: The winter temporary pasture crops were seeded as nearly as possible around October 15 following the summer annual pastures. Oats and rye were planted at the rate of 4 bushels per acre, hairy vetch 30 pounds, and rye grass 50 pounds per acre.

Good grade yearling Hereford steers were used in this test. The animals were kept on and taken from the annual winter pastures as needed to make

Table 77. Annual winter pastures: Tifton, Georgia, 1939-1940.

	Pasture			
	Oats and hairy vetch	Abruzzi rye	Oats following common lespezeza	Rye grass
Number of acres	6	6	6	6
Date on test	Feb. 14	Feb. 14	Feb. 14	Feb. 14
Date off test	May 3	May 3	May 3	May 3
Number animals grazed	6*	6**	6***	4****
Av. initial weight, lbs.	410	393	491	484
Av. final weight, lbs.	534	517	588	596
Av. gain per animal, lbs.	124	124	97	112
Av. liveweight gain per acre, lbs.	124	124	97	75

*Four of these animals placed on pasture April 3

**Four of these animals removed from pasture April 4

***Four of these animals placed on pasture April 4

****Two of these animals placed on pasture April 3

the most effective use of the crops. A mineral mixture composed of equal parts of salt, steamed bonemeal, and marble dust was kept before the cattle.

Table 77 shows the results of this test.

Reference: Georgia Coastal Plain Experiment Station Twentieth Annual Report, 1939-40, pages 44 and 45, table 29, Tifton, Georgia, July 1940.

Wintering Steers in Johnson Grass Hay Fields

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 1931-32.

Purpose: To compare wintering steers on hay fields and stacked Johnson grass hay, with wintering on hay fields and stacked Johnson grass hay plus 1 pound of cottonseed meal per steer daily.

Procedure and conditions: In lot 1 of this test the steers were wintered in Johnson grass hay fields with access to Johnson grass hay. In lot 2 the steers were wintered on Johnson grass hay fields with free access to stacked hay and 1 pound of cottonseed meal per steer daily.

It was not practical to keep a record of the hay eaten by the steers because the hay was self-fed from the stacks. Previous experiments have shown that steers such as the ones used in this test will not eat more than 15 pounds of hay daily. Fifteen pounds of hay per head daily are used in computing the results of this test.

The results are given in table 78.

Table 78. Wintering steers in hay fields in Alabama: 1931 and 1932.

	Lot 1			Lot 2
	Johnson grass hay fields with free access to stacked hay			Johnson grass hay field with free access to stacked hay and 1 lb. cottonseed meal per head daily
	1931	1932	2 yr. av.	
Number of steers wintered	17.0	20.0	18.50	20.00
Av. wintering period, days	140.0	125.0	131.90	125.00
Av. initial wt. per steer, lbs.	560.0	548.0	553.50	549.20
Av. final wt. per steer, lbs.	638.0	558.0	594.70	649.75
Av. gain per steer, lbs.	78.0	10.0	41.20	100.55
Av. daily feed per steer				
Johnson grass hay, lbs.	15.0	15.0	15.00	15.00
Cottonseed meal, lbs.	—	—	—	1.00

Reference: Alabama Agricultural Experiment Station Circular 71, "Wintering Steers in the Black Belt of Alabama," page 7, table 3, Auburn, Alabama, February 1935.

Johnson Grass Hay and One Pound Cottonseed Meal versus Johnson Grass Hay and Two Pounds of Cottonseed Meal

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 1929-1931.

Purpose: To compare Johnson grass hay and 1 pound cottonseed meal with Johnson grass hay and 2 pounds cottonseed meal, for wintering beef steers.

Procedure and conditions: Thirty-four steers were in each group during the first year, 15 in each group during the second year, and 17 in each group during the third year. The length of the different wintering periods was 119 days, 133 days, and 140 days, respectively. The hay was self-fed from racks in a barn, although both groups of steers had access to permanent pasture plots of approximately 10 acres. Both lots of steers made much greater gains in 1931 than during the two previous winters. This was due, no doubt, to the very mild winter of 1931. There was only one freeze recorded in Alabama during that winter.

Table 79. Johnson grass hay and 1 pound cottonseed meal versus Johnson grass hay and 2 pounds of cottonseed meal: 3-year average, 1929-1931.

	Lot 3	Lot 4
	Johnson grass hay, self-fed from racks, and 1 pound cottonseed meal per head daily	Johnson grass hay, self-fed from racks, and 2 pounds cottonseed meal per head daily
Number steers wintered	22	22
Average wintering period (days)	127.60	127.60
Average initial weight per steer, lbs.	545.00	543.00
Average final weight per steer, lbs.	593.00	586.00
Average gain per steer, lbs.	48.00	42.00
Average daily feed per steer:		
Cottonseed meal, lbs.	1.00	2.00
Johnson grass hay, lbs.	12.98	12.92

Reference: Alabama Agricultural Experiment Station Circular 71, "Wintering Steers in the Black Belt of Alabama," pages 5 and 6, table 2, Auburn, Alabama, February 1935.

Johnson Grass Hay versus Johnson Grass Hay and Cottonseed Meal

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 1926-1928.

Purpose: To determine the value of Johnson grass hay versus Johnson grass hay and cottonseed meal.

Procedure and conditions: Forty-five grade Hereford steers were wintered for 112 days on Johnson grass hay alone during the winters of 1926, 1927, and 1928. The hay was self-fed from racks in a barn and the steers were allowed free access to a 10-day permanent pasture. There were 10 steers on this ration during the first two winters and 25 steers during the third winter.

During the same 3-year period a similar number of steers in lot 2 were fed and managed in a similar manner to those in lot 1 except that they were allowed an average of 1.89 pounds of cottonseed meal per head daily in addition to the Johnson grass hay.

Table 80. Johnson grass hay alone versus Johnson grass hay and cottonseed meal for wintering steers, 3-year average, 1926-1928.

	Lot 1	Lot 2
	Johnson grass hay, self-fed from racks	Johnson grass hay self-fed from racks, and cottonseed meal
Average number steers wintered	15	15
Average wintering period, days	112	112
Average initial weight per steer, lbs.	572.44	583.11
Average final weight per steer, lbs.	526.33	610.22
Average gain per steer, lbs.	—46.11	27.00
Average daily feed per steer:		
Cottonseed meal, lbs.	—	1.89
Johnson grass hay, lbs.	16.71	16.16

Reference: Alabama Agricultural Experiment Station Circular 71, "Wintering Steers in Black Belt of Alabama," pages 3 and 4, table 1, Auburn, Alabama, February 1935.

The Value of Shelter for Fattening Steers in Alabama

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 1938-1939.

Purpose: To determine the value of shelter for fattening steers.

Procedure and conditions: During the winters of 1938 and 1939 two groups of native Alabama steers weighing from 500 to 600 pounds were fed cottonseed meal and sorghum silage. One group was confined in a small lot of about one-half acre with no shelter, while the other group was fed in a similar lot but was provided with a shed open to the south.

The results are given in table 81.

Table 81. Shelter versus no shelter for fattening steers: Alabama, 1938-1939.

	Lot 1	Lot 2
	Cottonseed meal, silage* and minerals no shelter	Cottonseed meal, silage and minerals shelter
Number of days	112	112
Number of steers in lot	10	10
Initial weight of lot, lbs.	4,861	4,861
Final weight of lot, lbs.	6,337	6,361
Total gain of lot, lbs.	1,476	1,500
Average daily gain per steer, lbs.	1.31	1.34
Total feed consumed per lot, lbs.:		
Cottonseed meal	5,205	5,205
Silage	53,525	51,762
Minerals	70	80
Feed consumed per hundred weight gain, lbs.:		
Cottonseed meal	350	345
Silage	3,602	3,363
Minerals	4.71	5.31

*Silage was made from sorghum cane after most of the heads had been removed from seed.

Reference: Alabama Agricultural Experiment Station Leaflet, "The Value of Shelter for Fattening Steers in Alabama," Auburn, Alabama.

MARKETING CATTLE

Beef cattle are marketed a number of different ways. In marketing cattle the farmers are interested in securing the highest price possible. There are a number of factors to be considered in marketing cattle. Some of these factors are: (1) shipping cattle, (2) prices, (3) market classes and grades of cattle. There are other factors involved in the marketing of cattle. A number of these factors need to be considered by individual producers in solving the marketing problems.

Shipping Cattle

In shipping cattle there is considerable information that may be helpful to the producer. A number of these factors are (1) minimum and maximum car loads, (2) freight rate per 100 weight, (3) ordering cars, (4) shrinkage in transit, (5) yardage and commission fees, and (6) handling of cattle in transit.

Information on minimum and maximum car lots and freight rates per 100 weight is shown in tables 82 and 83.

Table 82. Freight rates on cattle and calves.

Distance	Calves		Cattle	
	Single deck cars	Double deck cars	Handled by 1 railroad	Handled by 2 railroads
100	\$0.23	\$0.20	\$0.20	\$0.23
200	0.33	0.29	0.29	0.32
300	0.43	0.37	0.37	0.39
400	0.49	0.43	0.43	0.44
500	0.55	0.48	0.48	0.49

Reference: Southern Livestock Tariff, Freight Tariff 758A, Interstate Commerce Commission Publication 698, Issued July 12, 1941.

Table 83. Minimum and maximum carload weights.

	Calves				Cattle	
	Minimum		Maximum		Minimum	Maximum
	Single deck	Double deck	Single deck	Double deck		
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
36 foot car	16,000	20,000	20,000	24,000	20,000	28,000
40 foot car	17,000	22,272	22,000	26,000	22,272	32,000

Reference: Southern Livestock Tariff, Freight Tariff 758A, Interstate Commerce Commission Publication 698, Issued July 12, 1941.

Farmers interested in shipping cattle to market should notify the freight agents to order cattle cars 48 hours in advance of the time needed. When calves are to be shipped, the shipper and the freight agent must agree as to whether the animals to be shipped are classified as calves. In some instances the cattle are classified as calves on the basis of weight while in other instances they are classified according to age. The classification given will determine the freight rate.

Shrinkage

In an investigation made by W. F. Ward of the United States Bureau of Animal Industry, cattle in transit less than 24 hours shrank from 2.05 to 3.91 percent. Those in transit from 24 to 36 hours shrank from 3.46 to 6.3 per-

cent. Those in transit from 36 to 72 hours shrank 3.88 to 5.40 percent. Those in transit over 72 hours shrank from 3.96 to 7.00 percent. These figures are based on weight at origin and "filled" weight at market.

Yardage and Commission Charges

Yardage at Chicago costs 45 cents per head for cattle and 35 cents for calves arriving by rail. Cattle weighing 400 pounds or under are classified as calves. Maximum charges for yardage are \$24.50 for a single deck car and \$49.00 for a double deck car.

Commission charges for selling cattle at Chicago are as follows: 60 cents per head on lots of 16 to 30 head for cattle weighing 800 to 1200 pounds and 10 cents more per head for heavier or fewer cattle and 10 cents less for lighter cattle or each head over 30 in one consignment. The commission for selling calves is 25 cents per head in lots of 16 to 30 head and 20 cents for each head over 30, subject to a maximum charge of each consignment of \$20.00 for each single deck and \$25.00 for each double deck car. Buying charges are the same as selling charges with a maximum of \$15.00 for single deck cars and \$20.00 for double deck cars.

Handling Cattle in Transit

In shipping cattle by rail the law provides that cattle must be unloaded each 28 hours for an 8-hour period for feed and water unless cattle will reach destination in 36 hours from time of shipment. In this case the permission of the shipper must be obtained for direct shipment. Freight agents, to play safe, often get a 36-hour release signed by the shipper before the cattle are shipped.

Prices of Cattle

All beef cattle may be classified according to their use into two groups, (1) slaughter cattle and (2) feeder and stocker cattle. In turn, these groups are divided into classes and grades. On the central markets cattle are purchased on grade basis. It seems important that the cattle producers should be able to recognize the different grades of cattle as well as be familiar with the spread in prices between the different grades of cattle. In some instances producers cannot understand why cattle sold on the same market do not bring the same price. If the grading process were understood it is likely that this confusion would not exist.

In order to help clear up the confusion among cattle producers as to the variation in prices by grades it is thought advisable to show the monthly price of slaughter and feeder and stocker cattle by grades for a period of years on a monthly basis. It is impossible to get this type of information on the local Mississippi markets. Therefore, this information was secured for a central market, the central market used being Chicago. In planning a beef cattle production program the producer should examine the prices by grades in order that a decision may be reached as to the grade of cattle that can be produced under certain conditions. A number of livestock markets were contacted in Mississippi trying to get actual prices paid by grades for cattle. This information could not be secured from the records that were available. The owners of the livestock yards stated that prices paid ranged from $\frac{1}{2}$ cent to $1\frac{1}{4}$ cents per pound under the central market quotations. This being true,

the cattle producer in Mississippi can arrive at the approximate price by grades on Mississippi markets.

Table 84. Prices received for slaughter cattle at Chicago, 1938-42*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Av.
CHOICE AND PRIME													
1938	9.87	8.87	9.43	9.43	9.55	10.06	11.39	11.20	11.78	11.93	11.83	12.13	10.71
1939	12.19	11.98	12.45	12.10	11.26	10.03	9.80	9.51	10.85	10.38	10.24	10.50	10.48
1940	10.94	10.89	11.50	11.47	10.69	10.31	10.97	11.69	12.53	13.11	13.59	13.92	11.86
1941	14.19	13.56	12.80	12.57	11.56	11.32	11.76	12.06	12.27	12.04	12.26	13.69	12.50
1942	13.76	14.06	14.34	15.76	15.50	14.51	14.74	15.90	13.76	16.38	16.85	16.07	15.30
Av.	12.19	11.87	12.10	12.26	11.81	11.74	11.73	11.91	12.63	12.76	12.95	13.06	12.20
GOOD													
1938	8.29	7.91	8.49	8.49	8.69	9.12	9.98	9.69	10.03	10.01	9.99	10.16	9.14
1939	10.35	10.23	10.64	10.33	9.92	9.29	9.26	9.03	10.20	9.68	9.52	9.44	9.81
1940	9.44	9.53	9.86	10.01	9.92	9.57	10.29	10.82	11.15	11.72	11.73	11.96	10.48
1941	12.21	11.64	11.12	11.07	10.54	10.74	11.11	11.44	11.44	11.30	11.34	12.56	10.54
1942	12.55	12.60	13.26	13.93	13.80	13.16	13.83	14.87	14.38	15.04	15.35	14.90	13.97
Av.	10.57	10.39	10.67	10.76	10.57	10.38	10.89	11.17	11.44	11.55	11.58	11.78	10.97
MEDIUM													
1938	7.22	7.17	7.68	7.82	7.88	8.27	8.83	8.39	8.19	8.10	8.30	8.63	7.88
1939	8.76	8.94	9.21	9.09	8.99	8.54	8.55	8.11	9.00	8.54	8.59	8.44	8.77
1940	8.43	8.36	8.51	8.72	9.05	8.84	9.33	9.21	9.08	9.54	9.45	9.62	8.84
1941	10.13	9.90	9.69	9.68	9.60	10.03	10.43	10.12	10.05	10.13	10.18	10.79	10.06
1942	10.82	10.73	11.13	11.32	12.19	11.93	12.30	13.08	12.54	12.83	13.17	12.91	12.07
Av.	9.07	9.02	9.04	9.32	9.52	9.52	9.88	9.78	9.77	9.82	9.93	10.07	9.56
COMMON													
1938	6.41	6.35	6.86	7.08	7.07	7.18	7.29	6.98	6.58	6.57	6.96	7.08	6.77
1939	7.36	8.09	8.31	8.20	8.03	7.67	7.33	6.61	7.22	7.11	7.30	7.17	7.51
1940	7.40	7.30	7.37	7.73	8.22	7.69	7.59	7.27	7.12	7.08	7.49	7.83	7.51
1941	8.34	8.45	8.72	8.50	8.50	8.76	8.70	8.43	8.68	8.65	8.67	9.15	8.62
1942	9.27	9.03	9.46	10.19	10.81	10.59	10.49	10.93	10.65	10.78	10.66	11.06	10.32
Av.	7.75	7.84	8.14	8.34	8.52	8.37	8.28	8.04	8.05	8.03	8.21	8.45	8.16
Prices received for slaughter calves													
GOOD AND CHOICE													
1938	7.32	6.54	6.95	6.85	7.00	7.45	7.25	7.26	7.49	7.56	7.56	6.98	7.18
1939	7.27	7.48	7.87	7.21	7.91	7.89	7.57	7.40	7.98	7.87	7.39	7.30	7.59
1940	8.44	8.00	7.84	8.34	8.45	7.88	8.05	8.35	8.50	8.50	8.24	8.14	8.23
1941	8.76	9.25	8.92	9.00	9.00	9.42	9.60	9.75	9.89	9.31	9.25	9.59	9.31
1942	10.68	10.62	10.85	11.96	12.25	11.70	11.78	12.02	12.70	12.59	12.50	12.98	11.88
Av.	8.59	8.37	8.48	8.67	8.92	8.86	8.85	8.95	9.31	9.16	8.98	8.99	8.84
COMMON AND MEDIUM													
1938	5.42	5.14	5.55	5.62	5.62	5.62	5.62	5.62	5.66	5.68	5.68	5.53	5.56
1939	5.58	5.62	5.62	5.62	6.24	6.08	6.95	6.78	7.32	7.25	6.78	6.76	7.08
1940	7.12	6.93	6.68	6.93	7.10	6.75	6.65	7.10	7.37	7.03	6.82	6.80	6.94
1941	7.06	7.25	7.06	7.31	7.50	8.00	8.10	8.25	8.25	7.95	7.90	8.27	7.05
1942	9.25	9.00	9.12	9.70	10.00	9.68	9.77	9.90	10.29	10.24	10.25	11.62	9.81
Av.	6.88	6.78	6.80	7.05	7.29	7.22	7.41	7.53	7.77	7.63	7.48	7.59	7.28
CULL													
1939							5.94	5.56	6.00	6.00	5.56	5.64	5.78
1940	5.75	5.50	5.50	5.50	5.80	5.75	5.56	6.00	6.25	5.39	5.39	5.45	5.66
1941	5.77	5.75	5.84	6.22	6.50	7.00	7.00	7.09	7.09	6.69	6.65	6.84	6.53
1942	7.68	7.50	7.50	7.75	8.00	8.00	8.09	8.15	8.00	8.36	8.25	8.62	7.99
Av.	6.40	6.25	6.28	6.49	6.77	6.91	6.63	6.70	6.83	6.61	6.46	6.63	6.09

*Prices compiled by Agricultural Marketing Service, Washington, D. C.

Table 85. Prices received for feeder and stocker cattle at Chicago, 1938-1942*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Av.
CHOICE													
1938	7.34	6.90	7.95	8.25	8.25	8.30	8.57	8.98	8.92	9.01	9.22	8.88	8.37
1939	9.06	9.06	9.56	9.85	9.71	9.28	9.19	8.88	9.59	9.55	9.66	9.28	9.35
1940	8.92	8.97	9.27	9.33	10.17	9.17	9.93	9.92	10.11	10.32	10.27	10.29	9.73
1941	10.67	10.56	10.39	11.28	11.25	11.35	11.33	11.46	10.79	11.15	11.03	11.69	11.07
1942	11.49	11.37	12.23	13.06	13.07	13.32	12.58	13.08	13.31	13.65	14.01	13.89	12.92
Av.	9.49	9.37	9.88	10.35	10.49	10.28	10.32	10.46	10.54	10.73	10.83	10.84	10.29
GOOD													
1938	6.67	6.32	7.12	7.25	7.25	7.25	7.48	7.68	7.78	8.00	8.22	8.16	7.43
1939	8.31	8.31	8.83	9.07	9.02	8.68	8.55	8.25	8.94	8.79	8.72	8.55	8.69
1940	8.29	8.48	8.64	8.65	9.02	9.04	9.04	9.02	9.29	9.59	9.41	9.48	9.03
1941	9.80	9.62	9.71	10.24	10.25	10.45	10.45	10.45	10.54	10.32	10.24	10.89	10.30
1942	10.79	10.76	11.47	12.20	12.34	12.38	12.24	12.22	12.34	12.75	13.01	12.87	12.11
Av.	8.77	8.70	9.15	9.58	9.57	9.56	9.55	9.54	9.75	9.69	9.92	9.99	9.48
MEDIUM													
1938	6.10	5.90	6.62	6.75	6.75	6.75	6.93	7.08	7.00	7.12	7.35	7.46	6.82
1939	7.62	7.62	8.14	8.49	8.50	8.25	7.48	7.02	7.59	7.42	7.39	7.06	7.71
1940	7.62	7.70	7.94	7.86	8.35	8.28	7.91	7.93	8.16	8.34	8.26	8.32	8.06
1941	8.74	8.87	8.65	9.31	9.27	9.49	9.52	9.43	9.59	9.14	9.12	9.74	9.27
1942	10.00	10.00	10.46	11.09	11.12	11.09	11.06	11.51	11.31	11.41	11.62	11.87	11.04
Av.	9.01	8.01	9.36	8.50	8.80	8.77	8.38	8.59	8.73	8.68	8.74	8.69	8.51
COMMON													
1938	5.50	5.39	6.12	6.25	6.25	6.25	6.40	6.57	6.33	6.36	6.59	6.76	6.23
1939	7.02	7.12	7.64	7.88	7.88	7.62	7.48	7.02	7.59	7.42	7.39	7.06	7.43
1940	6.68	6.93	7.12	7.21	7.50	7.40	7.06	6.92	7.18	7.24	7.21	7.29	7.16
1941	7.69	8.00	8.03	8.25	8.05	8.21	8.49	8.31	8.37	7.72	7.53	8.49	8.12
1942	9.00	9.00	9.40	10.05	10.00	9.96	10.06	10.64	10.06	10.30	10.45	10.50	9.95
Av.	7.17	7.28	7.66	7.92	7.93	7.88	7.89	7.89	7.90	7.80	7.83	8.02	7.77
Prices received for feeder and stocker calves													
GOOD AND CHOICE													
1938								8.88	9.02	9.34	9.37		
1939	9.75	10.14	10.45	10.42	10.25	10.07	9.04	8.81	9.36	9.16	8.91	8.72	9.00
1940	8.62	8.62	8.88	8.98	9.64	9.82	9.64	9.20	9.60	10.14	9.79	9.62	9.38
1941	9.93	10.25	10.30	10.38	10.38	10.59	10.78	11.00	11.00	10.88	10.64	10.91	10.59
1942	11.00	11.00	11.34	12.22	12.50	12.40	12.25	12.44	13.00	13.17	14.08	13.93	12.36
Av.	8.82	10.00	10.24	10.50	10.66	10.72	10.42	10.38	10.36	10.47	10.55	10.51	10.33
MEDIUM													
1938								7.62	7.88	8.12	8.12		
1939	8.50	8.68	9.08	9.18	9.00	9.00	9.00	8.76	9.36	9.07	8.65	8.55	8.44
1940	8.50	8.59	9.05	8.89	9.24	9.14	8.82	8.68	9.08	9.52	9.50	9.50	9.04
1941	9.75	10.00	10.00	10.24	10.25	10.37	10.50	10.29	10.25	10.20	9.95	10.28	10.18
1942	10.34	10.25	10.62	11.14	11.58	11.80	11.64	12.05	12.61	12.74	12.45	12.50	11.64
Av.	9.27	9.38	9.68	9.86	10.01	10.00	9.99	9.97	9.78	9.88	9.74	9.79	9.77

*Prices compiled by Agricultural Marketing Service, Washington, D. C.

Market Classes and Grades of Beef Cattle

All beef cattle arriving at central markets fall into two general groups, (1) slaughter cattle and (2) feeder and stocker cattle, the former going for immediate slaughter, while the latter is returned to the farm for further feeding. Each of these two groups is in turn divided into different classes according to their age and sex. The ages generally referred to are calves, yearlings, 2-year-olds, and mature cattle, while the sex differences, and to some extent

the ages, are indicated by the terms: steers, heifers, cows, bulls, and stags. The animals in the various classes are then divided into grades according to their suitability for the purpose used. The grades for the slaughter classes are prime, choice, good, medium, common, cutter, and canner, while those for feeder and stocker classes are fancy, choice, good, medium, common, and inferior. This, in general, is the basis for such expressions as fancy steer calves, medium grade yearling slaughter heifers, common 2-year-old feeder steers, cutter cows, choice bulls, and others. The various market classes and grades are discussed in detail below.

SLAUGHTER CATTLE

Slaughter cattle are those possessing sufficient weight and finish to meet the requirements of the consuming trade. This designation covers all animals which will produce meat that is wholesome and fit for human food. This group of cattle may be defined as those individuals which are bought and sold for immediate slaughter. As a rule they have reached an age of approximately 6 months or over.

When slaughter cattle are sold on central markets the different classes are divided into grades. The cattle are divided into different grades on the basis of their conformation, finish, and quality at the time of sale. There are seven rather generally recognized grades for slaughter cattle. They are prime, choice, good, medium, common, cutter, and canner grades. The different grades of animals must meet certain qualifications to be placed in a certain grade. It seems important that the producer should have a very good idea as to the qualifications for the different grades. The description of the different grades of slaughter cattle is given below.

Grades of Slaughter Cattle

Prime Grade. Prime grade slaughter cattle very closely approach the ideal in conformation, finish, and quality. They are rectangular and very compact. The body is very broad and deep in proportion to its length. The head is very short and broad. The neck is very short and thick, and the legs are very short and set very wide apart. Top and underlines are straight and parallel, as are the lines of the sides when viewed from the front, rear, or from above. All parts are very thickly and evenly fleshed, each part having its proper proportionate thickness.

The animal carries a very thick, smooth, even, and firm covering of fat. The thickness of this varies. It is greatest over the back, brisket, twist, and rear flanks, and gradually diminishes over the sides and legs to the hock and knee joints.

The animal is very neat and trim in appearance. The bones are very small in proportion to the size and weight of the animal and the hide is medium in thickness. A prime grade slaughter steer is illustrated in figure 13.

Prime grade slaughter cattle are high grade, crossbred, or purebred individuals of beef type. Animals of this grade are rarely offered at the smaller livestock markets and are not regularly on sale even at the largest markets.

Choice grade. Choice grade slaughter cattle are markedly superior in their conformation, finish, and quality. Their general build or shape is rectangular and compact. The body is broad and deep in proportion to its length. Top and underlines are nearly straight and parallel, with the lines

of the sides presenting a like appearance when viewed from the front, rear, or above. The head is wide and short. The neck is short and thick, and the legs are short and set wide apart. The fleshing of each part is thick and even, having nearly its proper proportionate thickness. Each part has a degree of fullness in its lines which is much above the average, giving the animal a plump, full, well-rounded appearance. It lacks somewhat the plumpness and fullness of the prime grade steer. The way in which the different parts are developed and balanced indicates that the animal will have a high proportion of loins, ribs, and rounds in its carcass. The general appearance of the animal is neat and trim, reflecting superior breeding and handling as illustrated in figure 14. The bones are medium-sized and the hide is moderately thick and pliable.

Choice grade slaughter cattle are largely purebreds, crossbreds, or high grade individuals of beef type. They range from 1 year old and up in age. They are only occasionally offered at the smaller livestock markets.

Good grade. Good grade slaughter cattle have a moderately high degree of conformation, finish, and quality. They tend to be rectangular and are moderately compact. They are moderately broad and deep in proportion to length of body. When viewed from the front, rear, or above, the lines of the sides tend to be straight and parallel. The neck is moderately short and thick, the head is moderately short and wide, and the legs are moderately short and are set moderately wide apart. Top and underlines tend to be straight and parallel. The thickness of fleshing results in a degree of fullness and smoothness of each part which is noticeably beyond the average of steers as a class, and gives the parts a moderately full, plump, and rounded appearance. The



Figure 13. Prime slaughter steer. (Courtesy Agricultural Marketing Service, U.S.D.A.)

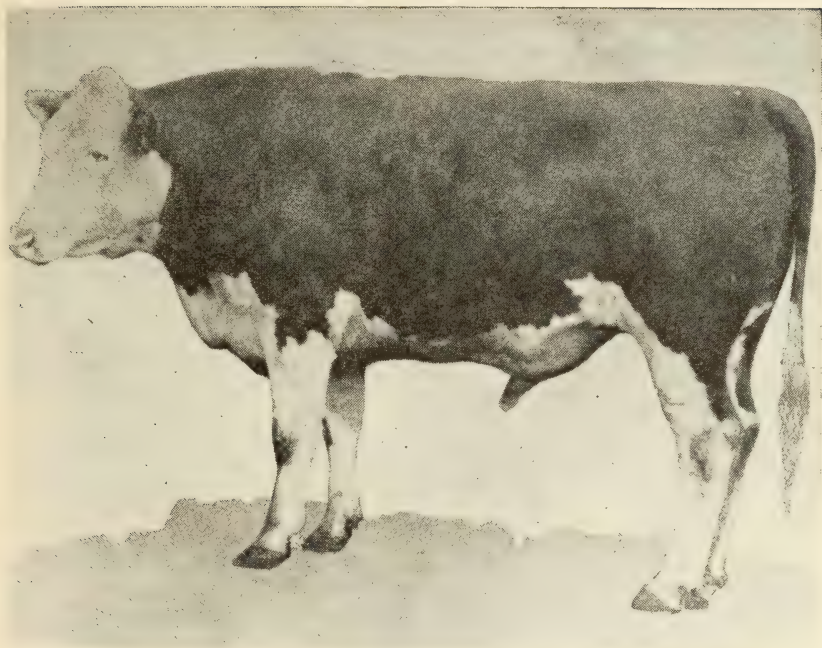


Figure 14. Choice slaughter steer. (Courtesy Agricultural Marketing Service, U.S.D.A.)

way in which the parts are developed and balanced causes the animals to have somewhat more than an average proportion of loins, ribs, and rounds in its carcass. This grade is illustrated in figure 15.

In most cases the animal is slightly too coarse or slightly too refined to be ideal, but shows reasonably good beef type breeding, feeding, and handling. The bones are either slightly too large or too small and the hide is either slightly too thick or slightly too thin.

Cattle of this grade range from about 1 year and up in age. They usually show a predominance of the blood of one of the recognized breeds of beef cattle but may show slight traces of dairy-type breed.

Medium grade. Medium grade slaughter cattle are noticeably deficient in conformation, finish, and quality. They are slightly rangy or angular. The body is slightly narrow and shallow in proportion to its length. The neck is slightly long and thin, and the legs are slightly long and are set slightly too close together. The top and underlines and the lines of the sides are slightly oblique and irregular. The fleshing is slightly thin and uneven. Because of the thickness of fleshing, the lines of the different parts are slightly depressed. The way in which the primal parts of the animal are developed and balanced results in a slightly low proportion of loins, ribs, and rounds in the carcass.

The animal is noticeably lacking in neatness of features and trimness of shoulders, rump, and leg joints and shows an evident lack of care in its handling, feeding, and breeding. The bones of the animal are slightly too large or too small, and the hide is slightly too thick or too thin. The grade of cattle is illustrated in figure 16.



Figure 15. Good grade slaughter steer. (Courtesy Agricultural Marketing Service, U.S.D.A.)

Cattle of this grade are for the most part animals in which the blood of one of the beef breed predominates but include many animals of pronounced dairy type. They are regularly on sale at practically all livestock markets.

Common grade. Common grade slaughter cattle are deficient in conformation, finish, and quality to a marked degree. They are rangy or angular. The body is narrow and shallow in proportion to its length, the head is long and narrow, the neck is long and thin, and the legs are long in proportion to depth of body and set much too close together. Top and underlines are uneven, oblique, and antiparallel to a marked extent, as are the lines of the sides. Such animals are rough over the shoulders, ribs, and hips; and the backbone has a considerable degree of prominence. The flesh covering the different parts is thin and causes the lines of each one of these to be depressed, sunken, or hollowed out in appearance. The parts are usually developed and balanced so that the individual has considerably less than an average proportion of loins, ribs, and rounds in its carcass. This grade of cattle is shown in figure 17.

Cattle of this grade are for the most part either very coarse or very refined in their general appearance. The flesh of the animal is soft, and in most cases it has only small quantities of intermuscular fat. The joints of the legs are in most cases markedly rough. The hide is unpliant and much too thick or thin, and the hair is harsh, dry, and decidedly lacking in oil.

Individuals of the common grade are as a general rule those in which the blood of one of the dairy breeds is predominant or they are of no particular type of breeding. Occasionally they are of beef type breeding. They range

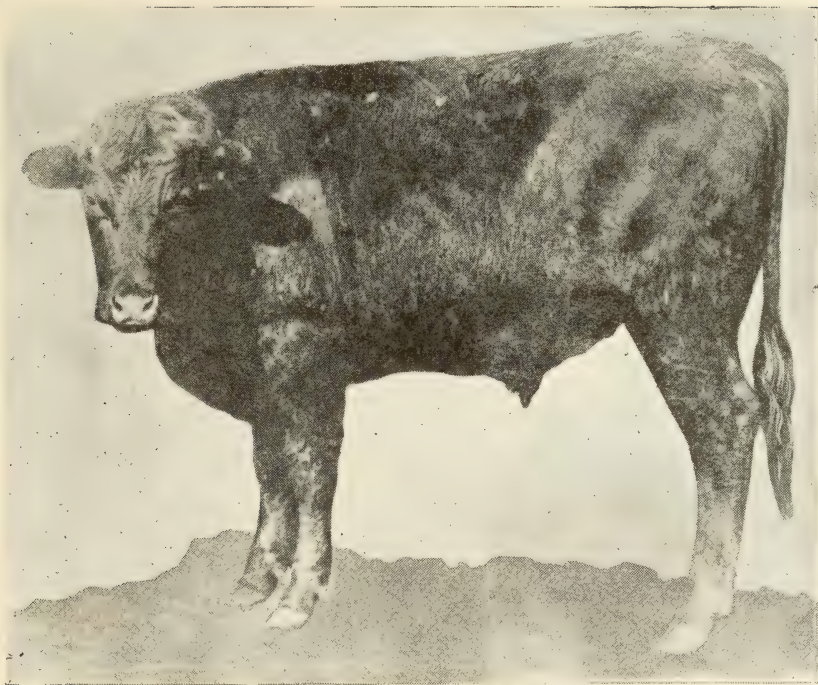


Figure 16. Medium grade slaughter steer. (Courtesy Agricultural Marketing Service, U.S.D.A.)

from 6 months up in age, but most offerings are from 2 to 4 years old. Practically all markets have a supply of them on hand throughout the year, but as a rule they are scarce during the late winter and spring months and abundant from the early part of summer until late in the fall.

Cutter grade. Cutter grade slaughter cattle are very inferior in conformation, finish, and quality. The general build or shape is very rangy or angular. The body is very narrow in proportion to its length, the neck is long and thin, and the legs are very long and set very close together. Top and underlines are very irregular and oblique and are far from parallel, and the lines of the sides are similar in general directions. Cutter grade cattle are very rough over the shoulders, crops, back, loins, hips, and rump. The bones of the shoulders, the hips, the backbone, and ribs are very prominent. They are very thin in flesh and the thinness of flesh causes the lines of each part to be depressed, sunken, or hollowed out to a very marked degree. The development and proportion of the different parts are such that the animal has a very low proportion of loins and ribs as illustrated in figure 18.

The bones are either very large or very small, and the hide is very thick or thin. The flesh is either very soft or slightly hard and has practically no intermuscular fat judging from the degree of external finish. The joints of the legs are usually very rough and coarse, the hide is almost invariably inelastic and tight, and the hair is nearly always very dry and harsh.

Cattle of this grade include a few individuals of beef-type breeding, but as a rule they are of pronounced dairy type or are nondescripts.



Figure 17. Common slaughter steer. (Courtesy Agricultural Marketing Service, U.S.D.A.)



Figure 18. Cutter grade slaughter steer. (Courtesy Agricultural Marketing Service, U.S.D.A.)

Canner grade. Common slaughter cattle are extremely deficient in conformation, finish, and quality. They are extremely rangy or angular. The body is extremely narrow in proportion to its length; the neck is extremely long, tapering, and thin, and the legs are extremely long in comparison to depth of body and are set extremely close together. Top and underlines are extremely irregular and oblique and very far from parallel, as are the lines of the sides. They are extremely rough over the shoulders, crops, back, loins, hips, and rump, and the bones of the shoulders and hips, the ribs, and the backbone are all extremely prominent. They are extremely thin-fleshed and the lines of each of the different parts are depressed, sunken, or hollowed out to very near the greatest possible extent. The animal has an extremely low proportion of loins and ribs in the carcass, which is indicated by the way in which the different parts are balanced as illustrated in figure 19.

The animal usually has a very unkempt and very poorly cared-for appearance. The bones are extremely large or small, and the hide is extremely thick. The flesh, as a rule, is either hard or extremely soft. The joints of the legs almost invariably are very rough. The hide is extremely thick or thin and unpliant and is tight; the hair usually appears extremely harsh and dry.

Most canner grade steers are so-called scrubs which are so badly mixed in breeding that no one type appears dominant, but they occasionally are of beef-type breeding.

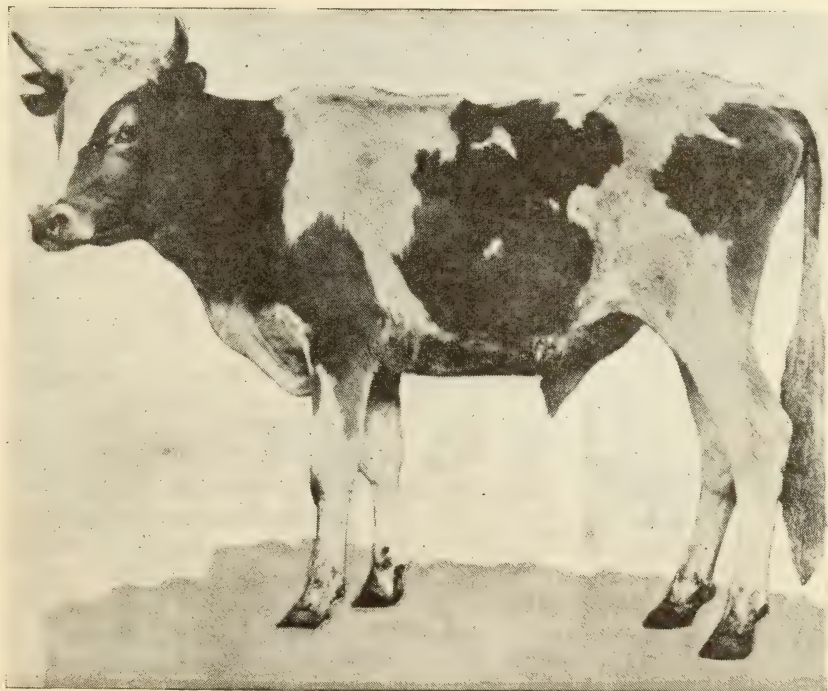


Figure 19. Inferior grade feeder steer or canner grade slaughter steer. (Courtesy Agricultural Marketing Service, U.S.D.A.)

Reference: United States Department of Agriculture Bulletin 1464, "Market Classes and Grades of Cattle," January 1927, slightly revised August 1940.

FEEDER AND STOCKER CATTLE

Feeders are animals which lack sufficient finish to produce the highest grades of meat but which show evidence of ability to take on additional flesh and fat economically, most of the gain resulting from additional fat or finish rather than growth.

Stockers are animals which not only lack sufficient finish to produce the high grade of meat, but are also usually immature and therefore capable of material additional growth as well as putting on additional finish.

Most feeder cattle are animals which have reached an age of approximately 18 months or over, although a considerable number of cattle are sold on the market as feeders which range from around 18 months down to 6 months in age. These are usually purebred, high grade, or cross bred animals of the beef type and as a general rule grade good or higher as feeders.

Young animals devote much of their feed to growth rather than to the accumulation of fat. Standard growth can usually be maintained by the coarser feeds almost as well as by the so-called concentrates. A producer that has roughage to dispose of will usually select young animals that are still growing. Such animals are referred to as stocker and as a rule they range in age from around 6 months up to 18 months old. In a number of cases, however, cattle above 18 months of age are sold as stockers.

Feeder and stocker cattle are divided into classes and grades as mentioned above.

At most large central livestock markets, trading feeder and stocker cattle is done largely on the basis of their grade, and in actual market practices there are six more or less generally recognized grades of feeder and stocker cattle. These grades are fancy, choice, good, medium, common, and inferior.

It seems important that the livestock producer should be able to recognize the different grades in order that they have some idea as to whether they are receiving the value of their cattle. General classifications for the different grades are given below.

Grades of Feeder and Stocker Cattle

Fancy grade. Fancy grade feeder and stocker cattle closely approach the top of the standard of conformation, finish, and quality. The head is very short and wide, and the neck is very short. They are very compact, the body being very wide and deep in proportion to its length, with legs which are set very wide apart and very short in proportion to depth of body. Top and underlines are approximately straight and level and the same is true of the lines of the sides. The chest is very wide and deep and the animal has an exceptionally good middle, being very full in the crops with a very straight wide back and loin, very long, well-sprung ribs, and a belly which is very wide and deep but not paunchy. The rear flank is low. The hips are wide; the rump wide, deep, and even, and the tail head is even with the back line. The thigh is very wide and deep and the twist is very deep with the seam of the twist appearing very low. All parts are moderately thick in fleshing, with the fleshing very even, each part having its proper proportionate thickness. The thickness of fleshing is such that the lines of the animal appear

moderately plump, full, and well-rounded. The different parts are balanced in a superior manner, insuring that the animal when finished and slaughtered will produce a very high percentage of ribs, loins, and rounds as illustrated in figure 20.

The animal is moderately refined, the head being clean-cut and chiseled in appearance. The bones of the legs are of medium size with the joints smooth and free from coarseness. The hide is pliable and moderately thick, and the hair is fine. The animal appears very quiet in disposition, having eyes which are large and bright with a placid expression. The flesh of the animal is usually firm.

Cattle of this grade are always high-grade, crossbred, or purebred individuals of beef type. Load lots of this grade must be uniform in color, age, weight, and breeding. The usual age limits for stocker cattle of this grade are 6 to 18 months, whereas feeder cattle of the same grade range from 18 to 30 months old for the most part or in a few instances somewhat older.

Choice grade. Choice grade feeder and stocker cattle are markedly superior in conformation, finish, and quality. The head is short and wide, and the neck is also short. They are compact, the body being wide and deep in proportion to its length, with legs which are set wide apart and short in proportion to depth of body. Top and underlines are approximately straight and level and the lines of the sides are straight and parallel. The chest is wide and deep and the animal has an exceptionally good middle, being full

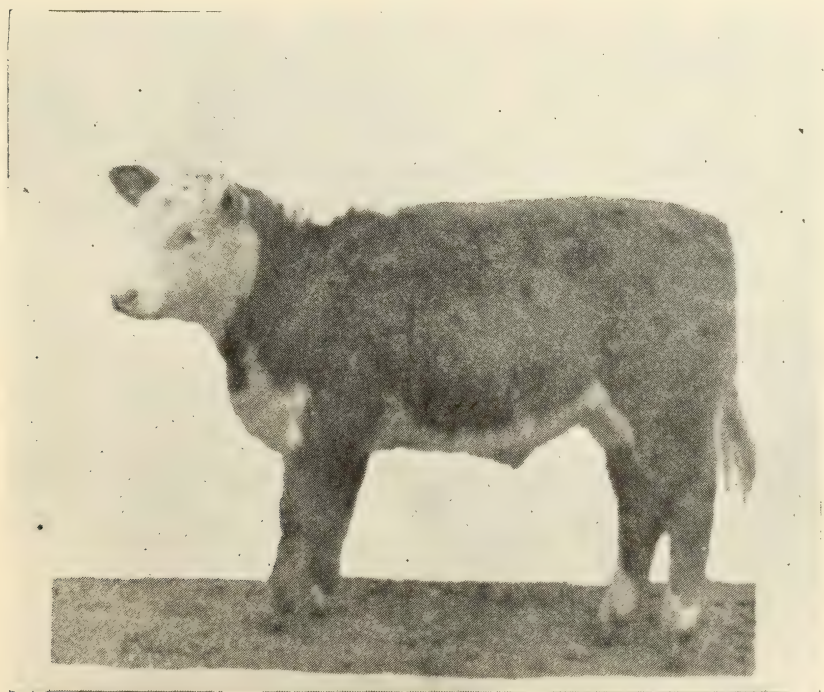


Figure 20. Fancy grade feeder steer. (Courtesy Agricultural Marketing Service, U.S.D.A.)



Figure 21. Choice grade feeder steer. (Courtesy Agricultural Marketing Service, U.S.D.A.)

in the crops with a straight wide back and loin; it has long, well-sprung ribs, and a belly which is wide and deep but not paunchy, together with a low rear flank. The hips are wide; the rump is wide, deep, and even, and the tailhead is even with the back line. The thigh is wide and deep and the twist is deep, with the seam of the twist appearing low. All parts are moderately thick in fleshing, with the fleshing very even, each part having very nearly its proper proportionate thickness. The thickness of the fleshing of the animal is such that its lines appear moderately plump, full, and rounded out. The different parts are balanced and developed in a manner which insures that the animal when finished and slaughtered will produce a high percentage of ribs, loins, and rounds as illustrated in figure 21.

The animal has a moderate degree of refinement, the head being clean-cut and chiseled in appearance. The bones of the legs are of medium size, with the joints smooth and free from coarseness. The hide is pliable and of medium thickness, and the hair is fine. The eyes are light and bright, with a placid expression, indicating that the animal has a quiet disposition and will be a good feeder in the feed lot.

Cattle of this grade are almost invariably high-grade, crossbred, or purebred individuals of beef type. Stocker cattle of this grade usually range from around 6 up to 18 months in age, whereas feeder cattle of the same grade range from around 18 to 30 months in most instances.

Good grade. Good grade feeder and stocker cattle have a moderately high degree of conformation, finish, and quality. The head is moderately short and wide, and the neck is moderately short. They are moderately compact, the body being moderately wide and deep in proportion to its length, with legs which are set moderately wide apart and are moderately short in proportion to depth of body. Top and underlines tend to be straight and level,

and the lines of the sides tend to be straight and parallel. The chest is moderately wide and deep and the animal has a good middle, being moderately full in the crops with a moderately wide back and loin; it has noticeably long, well-sprung ribs, and a belly which is moderately wide and deep but slightly paunchy, together with a moderately low rear flank. The hips are noticeably wide, and the rump is moderately wide and deep. The thigh is moderately wide and deep and the twist is also moderately deep, with the seam of the twist appearing moderately low. All parts are slightly thin in fleshing but the fleshing is moderately even, each part tending to have its proper proportionate thickness. Because of the slightly thin fleshing of the animal the bones of the shoulders and the hips are often slightly prominent, but the lines of the animal tend to be straight. The way in which the different parts of the animal are balanced indicates that it will have a moderately high percentage of ribs, loins, and rounds in its carcass when finished and slaughtered, as illustrated in figure 22.

The animal is usually slightly too coarse or too refined, but reflects reasonably good beef-type breeding and care. The bones of the legs are usually slightly too large or too small. The joints of the legs may be slightly rough and coarse. The hide is slightly too thick or too thin, slightly pliant, and the hair is moderately fine. As a rule, the flesh is slightly soft.

Cattle of this grade are usually high-grade, crossbred, or purebred individuals of beef type, but some of them occasionally show traces of dairy-type breeding, which is indicated by their color markings.

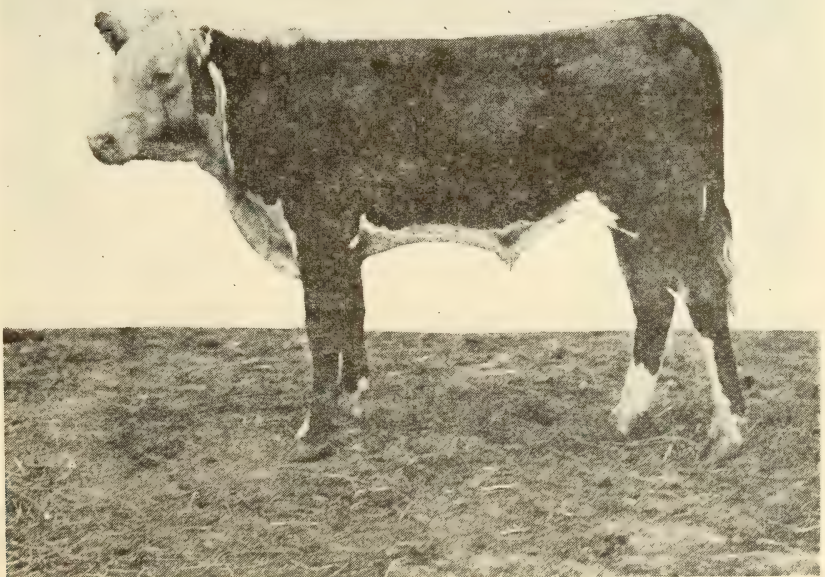


Figure 22. Good grade feeder steer. (Courtesy Agricultural Marketing Service, U.S.D.A.)



Figure 23. Medium grade feeder steer. (Courtesy Agricultural Marketing Service, U.S.D.A.)

Medium grade. Medium grade feeder and stocker cattle are slightly deficient in conformation, finish, and quality. The head is slightly long and narrow, and the neck is also slightly long. They are slightly rangy, the body being slightly narrow and often slightly shallow in proportion to its length with legs which are set slightly too close together and slightly long in proportion to depth of body. Top and underlines are slightly irregular and oblique as are the lines of the sides. The chest is slightly narrow and shallow and the animal has a slightly poor middle, being slightly sunken or hollow in the crops with a slightly narrow back and loin; it has slightly short, flat ribs; a belly which is paunchy, and a rear flank which is noticeably high. The hips are slightly narrow, the rump is slightly narrow and peaked, and the tailhead is slightly high or drooped in comparison with the rest of the top line. The thigh is slightly narrow and tapering and the twist is slightly shallow with the seam of the twist appearing slightly high. All parts are thin in fleshing and the fleshing is usually uneven. Because of the thinness of fleshing, the bones of the shoulders, the hips, as well as the backbone, and the ribs appear prominent to a marked degree. The different parts of the animal are so balanced that it is apparent that it will have a slightly low percentage of ribs, loins, and rounds in its carcass when it is finished and slaughtered, as illustrated in figure 23.

The animal is coarse and slightly lacking in refinement, usually evidencing rather poor beef-type breeding. The bones of the legs are much too large or too small. The hide is much too thick or too thin, tight, and unpliant. As

a rule, the hair is slightly coarse, dry, and harsh; and the flesh is soft in most instances.

Cattle of this grade usually have a predominance of the color markings of one or the other of the different breeds of beef-type cattle. Their general conformation as well as their color markings, however, usually indicates that they are more or less crossed in breeding with dairy-type animals. As a rule, stocker steers of this grade range from around 8 months up to 18 months in age, and feeders from around 18 months up to 3 years old.

Common grade. Common grade feeder and stocker steers are very deficient in their conformation, finish, and quality. The head is long and narrow, and the neck is also long. They are rangy to a marked degree, the body being narrow and oftentimes shallow in proportion to its length. The legs are set close together and are very long in proportion to depth of body. Top and underlines are irregular and oblique as are the lines of the sides. The chest is narrow and shallow, and the animal has a poor middle. The crops, as a rule, are hollow and depressed, and the back and loin are narrow and low in many instances. The ribs are short and flat. The belly is very paunchy, and the rear flank is high. The hips are narrow; the rump is narrow and peaked with the tailhead much too high or drooped. The thigh is narrow and deficient, and the twist is shallow with the seam of the twist appearing shallow and high. All parts are very thin in fleshing, causing the bones of the shoulders and the hips, the backbone, and the ribs to appear prominent



Figure 24. Common grade feeder steer. (Courtesy Agricultural Marketing Service, U.S.D.A.)

to a marked degree. The way in which the different parts of the animal are balanced indicates that it will have a low percentage of ribs, loins, and rounds in its carcass when it is finished and slaughtered, as shown in figure 24.

Steers of this grade are for the most part unkept, ill-bred, and ill-cared-for in their general appearance. The bones of the legs are very large or very small. The hide is very thick or thin and very unpliant, and the hair generally appears dry and harsh. The flesh is usually very soft or may be slightly hard in some instances.

Steers of this grade usually indicate by their general conformation that they are of pronounced dairy-type or nondescript breeding, but they generally have a predominance of the color markings of beef-type animals. Stocker cattle of this grade usually range from 1 year up to around 2 years in age with feeder cattle of the same grade falling within the age limits of 2 to 3 years.

Inferior grade. Inferior grade feeder and stocker cattle are very deficient in their conformation, finish, and quality. The head is very long and narrow, and the neck is also very long. They are very rangy, the body being very narrow and often very shallow in proportion to its length. The legs are set very close together and are extremely long in proportion to the depth of body. Top and underlines as well as the lines of the sides are very irregular and oblique. The chest is very narrow and shallow, and as a rule the animal has a very poor middle. The crops are very empty and hollow, and the back and loin very narrow. The ribs are very short and flat, and the animal is extreme-

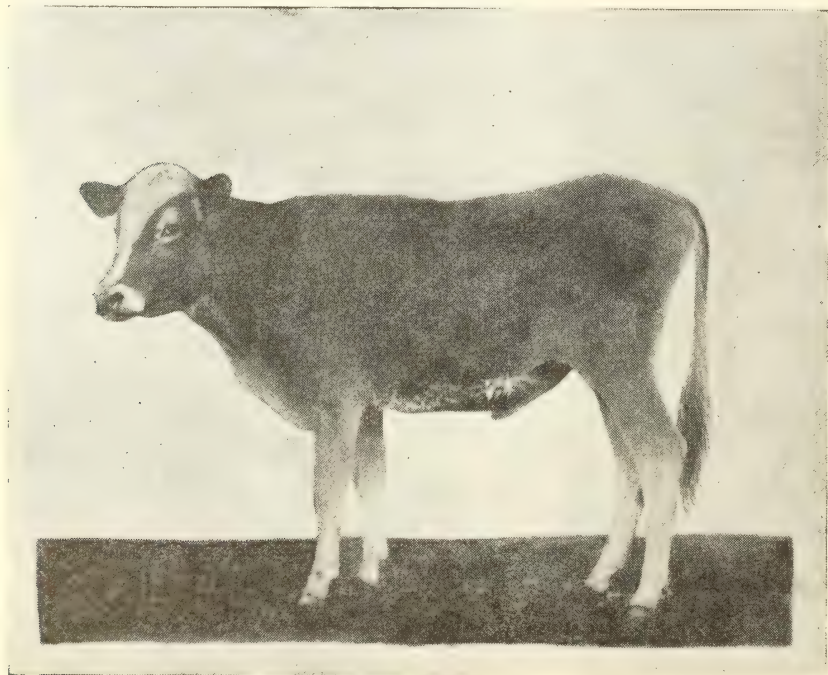


Figure 25. Inferior grade feeder steer. (Courtesy Agricultural Marketing Service, U.S.D.A.)

ly paunchy, with the rear flank appearing very high. The hips are very narrow, and the rump is very narrow and peaked, with the tailhead appearing very high or drooped when compared with the back line. The thigh is very narrow and tapering, the twist is very shallow, and the seam of the twist is very high. All parts are extremely thin in fleshing, and the bones of the shoulders, the hips, the backbone, and the ribs are all extremely prominent. The parts of the animal are balanced so that it will have a very low percentage of ribs, loins, and rounds in its carcass when it is finished and slaughtered, as illustrated in figure 25.

Steers of this grade are usually of very decided dairy-type or nondescript breeding as evidenced by their conformation, and a considerable number of them have the color markings, indicative of dairy-type breeding. Stocker cattle of this grade usually range from around 1 year up to about 2 years of age, whereas the same grade of feeder cattle are usually from 2 to 3 years old.

Reference: United States Department of Agriculture, Department Bulletin 1464, "Market Classes and Grades of Cattle," January 1927, Revised August 1940.

DISEASES AND PARASITES OF CATTLE

Losses of cattle due to diseases and parasites amount to many thousands of dollars in Mississippi each year. Often the losses due to diseases and parasites represent the profit that a producer would have made if the losses had been prevented. In many instances cattle are lost without the producer knowing the cause. Losses of this kind are dangerous, in that an entire herd may become infected with a disease or parasite before the producer realizes it.

Livestock producers should be able to recognize and know how to treat the more common diseases and parasites of cattle. Farmers being able to recognize and treat diseases and parasites will many times save a veterinarian's bill as well as the value of the livestock. This knowledge is also important due to the scarcity of veterinarians.

In presenting information on beef cattle production it seems important that information on the more common diseases and parasites should be included.

Diseases

There are a number of cattle diseases. The more common diseases in Mississippi are blackleg, anthrax, Bang's disease (infectious abortion), and Infectious Keratitis or pinkeye. Information is presented in this publication on the symptoms and treatment of these diseases.

BLACKLEG

Blackleg is an acute infectious and usually fatal disease which attacks young cattle between 6 months and 2 years of age.

Usually the organism gains entrance into the body of the animal through small cuts or punctures in the skin; large cuts or open wounds are not favorable for growth of the organism. In some cases the organism may enter the body through abrasions in the mucous membranes of the tongue, mouth cavity, or throat.

Symptoms

The symptoms of blackleg are so characteristic that it is possible to recognize the disease easily. The first symptoms to be noted are high fever, loss of appetite, and a suspension of rumination, followed by great depression. Breathing becomes more rapid than normal. In most cases the animal has difficulty in moving about, and it frequently lies down. Rapidly developing swellings or tumors in the tissues under the skin are characteristic. They may appear on the neck and shoulders, beneath the breast, and on the flanks and thighs, and in some instances they appear on the gums, the base of the tongue, and the wall of the pharynx. The tumors are accompanied by severe febrile symptoms. At first small and painful to the touch, they rapidly increase in size and may cover a considerable part of the body. Upon pressure the tumors make a peculiar crackling sound which is due to the collection of gas formed by the causative micro-organisms.

As the swellings increase in size, the symptoms become more intense. The temperature may reach 107° F., and the respiration may increase to 140 or more a minute. The animal is unable to rise, the extremities become cold, and the temperature usually falls and may become subnormal shortly before death. Violent convulsions and trembling of the muscles are noted before

death. Although there are some recoveries, death generally occurs in 12 to 36 hours after the first appearance of the disease.

The carcass of an animal dead from blackleg soon becomes distended by gas, partly through fermentation in the gastrointestinal tract and partly through the formation of gas in the tissue under the skin. Marked distention is noted in the region of the blackleg tumors and where there is loose tissue, especially between the shoulder and chest and on the outer surface of the hindquarters. In many instances this distention causes the legs on the upper side to stand out straight from the body. Shortly after death a dark, blood-colored, frothy discharge flows from the nostrils and anus. An incision made through the skin into the affected muscle tissue fails to demonstrate any decomposition, but it is possible to detect a characteristic sweetish-sour odor.

The skin covering the blackleg tumors is affected with dry gangrene. The distended muscles, which are easily torn, are dark brown or black, and the spaces surrounding them are filled with bloody liquid and gas. The blood in the badly affected parts of the body is thick and charged with gas and has a disagreeable odor. In the remaining parts of the carcass the blood is normal and coagulates easily after death, forming a solid clot. Hemorrhages are found on the heart and lungs. The spleen is always normal, but congestion is noted in the liver.

Thus it may be seen that a post-mortem examination should serve to distinguish blackleg from other diseases. Nevertheless, though a diagnosis may be made at autopsy, it is sometimes advisable to send specimens from affected animals to the laboratory for a conclusive diagnosis.

Treatment and Prevention

Medicinal treatment of animals has thus far proved unavailing. The only reliable and effective means known for protecting animals against blackleg is vaccination, which has been thoroughly tried and proved to be reliable.

Vaccines for protection against blackleg have been greatly improved in recent years. Those produced at the present time include blackleg bacterin, natural aggrassin, cultural aggrassin, cultural vaccine, and tissue vaccine. These vaccines are used extensively in the United States and give excellent results, as they confer immunity without producing any vaccination disease.

As vaccine is a preventative and not a curative agent, it is useless to vaccinate an animal after the symptoms of blackleg have developed. The immunity conferred by vaccination varies according to the kind of vaccine used and may last 12 to 18 months or longer.

When blackleg occurs on a ranch or farm it is of the utmost importance that owners of cattle in the district realize that every animal affected with the disease may be the means of propagating and disseminating the infection. Losses may not occur immediately on infected premises; in some cases they occur only after a lapse of years. It is recommended, therefore, that every effort be made to reduce the danger of infection by taking appropriate measures of disposal of all dead animals and with them the infection they carry. The carcass should be entirely destroyed by burning if this is possible. Otherwise a hole 6 feet deep should be dug and the body placed therein and well covered with quicklime before the earth is filled in. Any place where the animal was lying should be thoroughly sprinkled with a strong disinfectant,

such as a solution of commercial lye and hydrated lime ($2\frac{1}{2}$ pounds of lye and $2\frac{1}{2}$ pounds of lime in $8\frac{1}{2}$ gallons of water).

The eradication of blackleg infection from pastures is difficult. In most cases it is impossible to pasture livestock on other land long enough for the infection to die out. It appears, therefore, that vaccination is the only practicable and effective means of protecting cattle against blackleg. If vaccine is used year after year to prevent the development of new cases over a long period, it is possible that the old infection will finally disappear.

Reference: 1942 Yearbook of Agriculture, "Keeping Livestock Healthy," pages 523-525.

ANTHRAX

Anthrax is an infectious disease of livestock caused by a specific micro-organism or germ known as the anthrax bacillus (*Bacillus anthracis*) and characterized in its most common form by a rapidly fatal course or by sudden death. The disease causes annual losses of many millions of dollars to the livestock industry. As it is also infectious to man, anthrax is a menace to public health.

Susceptibility of Animals

Practically all animals are susceptible in some degree to anthrax, but the herbivorous animals are most susceptible. Cattle, horses, sheep, goats, and wild herbivorous animals are most commonly affected, and in the animals the disease usually appears in the acute form which rapidly terminates in death.

Modes of Infection and Dissemination

It is generally considered that anthrax infection for the most part occurs by way of the digestive tract.

Contaminated drinking water is also a potent source of infection.

Infection may also occur by way of the skin through anthrax spores from the soil lodging in wounds and abrasions or through punctures made by biting insects that had previously fed on diseased animals.

Soils contaminated with anthrax remain dangerous for long periods, requiring only favorable climatic and moisture conditions to cause repeated outbreaks of the disease and the consequent reinfection of the land. Additional territory may in turn become contaminated through the wandering of diseased animals.

Dogs and other carnivores, as well as the carrion-eating animals and birds, are potential spreaders of anthrax from one area to another.

Some of the flying insects must be considered as potential spreaders of anthrax, feeding as they do on the blood of living animals or on the materials that escape from the natural openings.

Streams contaminated with surface drainage from anthrax-infected land or by carcasses of animals dead of anthrax may convey germs many miles downstream, infecting the territory through which they pass.

Symptoms

According to the course of the disease, anthrax is recognized in three forms: A peracute form, in which the interval between the first outward man-

ifestation of symptoms and death is but a few hours or even minutes; an acute form, in which the disease lasts for a day or two; and a subacute form, in which the period between first symptoms and death or recovery extends beyond several days.

In the peracute form of the disease, death occurs so quickly that clinical symptoms are seldom observed. In the great majority of instances animals that when last seen were apparently in perfect health are found dead. Less often a seemingly healthy animal is seen to fall to the ground, go through a few convulsive movements, and die. Closer examination frequently shows blood-stained discharges from the nose, mouth, and anus. Peracute anthrax occurs most often in the beginning of an outbreak among cattle and is the **most common form of the disease in sheep**. Sudden death in cattle, sheep, and horses in areas where anthrax previously existed should always be viewed with suspicion and the owner should be on the lookout for anthrax.

In cattle, in addition to the peracute form of the disease in which few symptoms are seen, acute and subacute infections develop. In these forms there is first a stage of excitement, which is soon followed by depression. In this stage the animal lags behind, with the head hanging low, refuses to eat, and prefers to stand still or to lie down. Respiration is more rapid than normal and appears to be labored. Rumination ceases, and in milking cows the milk secretion is materially lessened. Pregnant animals may abort. At this stage of the disease the body temperature is elevated and may reach 108° F. Bloody discharges usually come from the natural body openings. When diarrhea sets in, the feces are usually blood-tinged. Small hemorrhages may be noted on the visible mucous membranes. Soft swellings that pit on pressure may develop over the body, but the more common sites are about the external genitalia and on the lower wall of the abdomen. The tongue also may show extensive swelling and dark discoloration.

Shortly before death respiration becomes extremely labored, the mucous membranes take on a bluish cast, and the temperature falls below normal.

Anatomical Changes

If anthrax is suspected, the stockman should consult a veterinarian at once rather than open up a carcass for the purpose of making a definite diagnosis. The seriousness of such a mistake can hardly be overestimated owing to the greatly increased danger of spreading the disease when the body is opened and discharges from it escape. Post-mortem examination in suspected cases of anthrax should be made by a qualified veterinarian who is prepared to take all necessary precautions against infecting himself and the premises.

Carcasses of animals dead of anthrax decompose rapidly and soon become greatly bloated. The natural post-mortem stiffening of the muscles is incomplete. Dark blood escapes as a rule from the natural openings, and the visible mucous membranes are dark blue in color and frequently show hemorrhages. The blood is considerably darker than normal, does not clot readily, and is frequently spoken of as being tarry. Hemorrhages beneath the skin are common. Clear or somewhat blood-tinged gelatinous exudates are found between the muscles and beneath the skin, especially in the areas where the swellings were seen before death.

Control Measures

Anthrax is a menace to the livestock industry and requires the concerted defensive action of livestock sanitary officials, local veterinarians, and owners. When the disease threatens or invades one's herd, it is advisable to obtain the assistance of a qualified veterinarian or State official, who is in a position to advise intelligently on the most effective means of control.

The first line of defense against anthrax consists of the prompt and proper disposal of animals dead of the disease.

The second line of defense is vaccination for prevention or cure in accordance with methods recommended by livestock sanitary officials and other experienced veterinarians.

The third line of defense consists in fencing, wherever practicable, to exclude livestock from pools, swamp land, and pasture where anthrax infection is known to exist.

Disposal of Carcasses and Disinfection

In the control of anthrax prompt and effective disposal of carcasses is of greatest importance. It is good practice to dispose of all animal carcasses properly, especially in an anthrax area, even though the possibility of anthrax may at the time seem remote. This can be accomplished either by complete cremation or deep burial under a layer of quicklime covered with at least 6 feet of earth. Carcasses should not be buried in low swampy land or adjacent to streams where overflow might inundate the grave or on a hillside where there is a possibility of subsurface drainage reaching the surface at lower places nearby. The area above and around the grave should be saturated with oil and burned over. The method to be employed will be governed by the prevailing weather conditions and the relative promptness and ease with which each procedure can be carried out at the place where disposal becomes an issue.

In disposing of a dead animal the following method is recommended: Immediately after finding the animal, cover it with kerosene or crude oil to keep flies, dogs, buzzards, crows, and vermin from the carcass until it is disposed of. If conditions permit, cremate or bury the carcass where it is found. If moving to a more suitable site is necessary, take the greatest care to prevent any discharges or hair from contaminating the soil over which the carcass is moved. Consequently, never permit a carcass to be dragged. A stone boat or sled may be used as a means of conveyance. Thoroughly disinfect or burn any equipment used in moving anthrax-infected carcasses. Avoid actual contact with the germ-laden body; this can be done through the use of properly applied ropes and poles, which may then be burned. Prepare a solution of bichloride of mercury to disinfect the hands and boots or shoes of the operator after the disposal of the carcass has been completed.

Preventative Vaccination

Where anthrax appears more or less regularly each year, vaccination affords the best means of holding the losses to a minimum.

Proper immunization against anthrax is a highly technical problem that involves the understanding of the principles of immunity, as well as expert knowledge of the available immunizing agents, the nature of each product,

the immunizing value of each, and its limitations. Anthrax vaccination is, therefore, a procedure that should be under the immediate supervision of a qualified veterinarian.

Treatment

When the progress of the disease is not too rapid, treatment with large doses of anti-anthrax serum administered by a qualified veterinarian is frequently successful. When used either as a preventative or as a curative there is no danger of giving an overdose of the serum, but there is a possibility of giving quantities which are insufficient to accomplish their purpose. No other known product, drug, or combination of drugs can be depended on to cure an established case of anthrax in animals.

Reference: United States Department of Agriculture Farmers' Bulletin 1737, "Anthrax," October, 1934.

BANG'S DISEASE (INFECTIOUS ABORTION)

Bang's disease, infectious abortion, contagious abortion, and abortion disease are different names for a livestock disease, especially prevalent in cattle, that causes heavy losses in the United States and most other countries. It has existed for centuries although for a long time its cause remained obscure. During recent years it has gained additional prominence and has become a matter of growing concern to those engaged in raising or handling cattle. As interest in the production of better stock has increased and as the long-distance shipment of animals has become more common, conditions have not only become more favorable for the spread of the disease but have made the losses which it causes of greater consequence to cattle owners.

Nature of the Disease

Although the act of abortion is the most readily observed symptom of the disease, it has been noted also that in affected herds (1) sterility, or barrenness, is commonly more or less troublesome; (2) animals give birth to calves which, although living may be too weak to resist some of the more common ailments; (3) cows show a tendency to retain their afterbirths, and (4) a reduced milk production is occasioned by the failure of animals to complete their normal gestation periods. Losses due to these conditions may equal or even exceed those represented by the number of calves that are born dead.

Location of *Brucella Abortus* in Infected Animals

The act of abortion furnishes little information as to when the disease was contracted or when it will be overcome by an animal. The tendency on the part of the germs to multiply in the bodies of animals for long periods justifies the recognition of the disease as a chronic malady.

The fetus, fetal membranes (afterbirth), and discharges from the generative organs at the time of aborting and for a variable period afterwards are usually saturated with the germs. Discharges shortly before the act may also contain the infection.

The aborting animal, moreover, is not alone responsible for scattering the infection. Infected cows, although they produce seemingly normal calves,

may be as menacing to healthy stock as if they had aborted, because their afterbirths and uterine discharges may contain myriads of the abortion germs, a feature that until recent years escaped observation.

Only in rare instances have the germs been found in the genital tracts of cows for any great length of time after the dead or living calf has been expelled. Experimental tests indicate that they are seldom present in the discharges longer than 3 or 4 weeks although in rare instances they have been found nearly 2 months after the expulsion of the calf or fetus.

The udders of many infected cows, whether they abort or not, contain and eliminate the germs for a widely variable period. Investigators have never been able to understand or account for the wide variation that exists in the length of time that udder infection persists in different animals.

Symptoms

The symptoms or signs that denote the presence of Bang's disease are rather inconstant and indefinite. The act of abortion is probably the most widely known and most readily observed, but it may easily be misinterpreted, since not all cows that abort are affected with the disease. Its prompt recognition in diseased herds is, moreover, rendered difficult because of the fact that many animals that acquire the disease never abort.

When the act of abortion occurs it may be preceded by changes commonly observed in cows approaching normal parturition, such as enlargement of the udder, slight swelling of the external genitals, uneasiness, and straining. Discharges from the genital tract preceding the act may occasionally be observed. The fetus may be expelled during any stage of its development. If the fetus is small, the act of abortion may occur unobserved.

When the dam aborts during the early months of pregnancy, the afterbirth, not being firmly attached to the uterus, is usually expelled with the fetus, whereas during the latter months of gestation its retention is common. Some fetuses may be born alive but too weak to survive more than a day or two.

Fluid or semifluid materials are eliminated from the genital tracts of aborting animals for a variable period following the act. The length of time that such discharges continue to be expelled depends on both the severity of the disease in the uterus and the manner of treatment employed. The discharges are usually brownish or yellowish brown, but may not differ greatly in appearance from discharges in cases of retained afterbirth, not caused by the abortive germ. The afterbirth, when expelled or removed and examined before becoming markedly putrefactive, frequently shows changes that aid the trained observer in recognizing abortion disease.

Areas of the membrane that are normally thin and translucent may present a leathery appearance or be studded with small elevations, and the borders of the cotyledons (tumor-like enlargements where union between dam and fetus is established), may consist of a cheese-like substance. The irregular surface of some of the cotyledons may likewise be occupied by this cheese-like material. The absence of these changes, however, does not necessarily indicate that the abortive germ has not been active.

Diagnosis

Cattle owners have shown unusual interest in the diagnosis of Bang's disease, since it plays such an important part in eradication programs. There has been some skepticism about the reliability of the agglutination test, the one commonly used. Before the discovery that the infection may establish itself in the udders of cows and be eliminated in the milk for long periods of time, there were reasons for doubting the accuracy of the test. The fact that many reacting animals have produced living vigorous calves has sometimes been erroneously regarded as indicating that the test is unreliable. It is now well known that the results of the agglutination test throw very little light on whether or not tested animals will abort, but they do give a reasonably accurate idea as to whether the animals harbor the abortion germs in their bodies. It is true that many animals recover from Bang's disease and cease to be carriers of the abortion germs after once having contracted the disease, and also that the test fails to differentiate sharply between present and past infections. However, it is possible to distinguish with considerable accuracy, between present and past infection, by the intensity of reaction.

Treatment

Treatment in many cases should be given the aborting animal, particularly when there is retention of the afterbirth. Vaginal and uterine douches with nonirritant, antiseptic fluids or solutions of common salt, when properly made, seem to hasten recovery of the generative organs and frequently prevent subsequent barrenness. Treatment of this character, however, should be undertaken with the idea of washing the germs out of the generative organs and relieving inflammation, and not with the expectation that abortion germs will thereby be completely destroyed.

Control and Eradication

Although the disease may be excluded from noninfected herds with reasonable care, it is much more difficult to eradicate it from infected herds. It is especially discouraging when the disease is running rampant and abortions are occurring frequently. Under these conditions animals may abort unexpectedly in many cases and scatter infectious material over wide areas before being discovered and separated from the rest of the herd. Success in dealing with the problem under these conditions is likely to involve considerable expense. On the other hand, if the disease is more quiescent, and comparatively few abortions occur, the problem of eradication may be greatly simplified.

It is doubtful whether or not any one method of dealing with infected herds is well adapted to the needs of every herd owner, and will deal satisfactorily with all degrees of infection.

Test-and-Slaughter Method

The test-and-slaughter method is similar to the one used so effectively in the eradication of tuberculosis. This method involves the immediate disposal for slaughter of the animals which react to the test, and thorough disinfection of the stables. In following this plan it is necessary that repeated tests of the herd be made at intervals of from 30 to 60 days, and that the same disposition be made of any subsequent reactors before they have had an opportunity to abort and spread the infection.

Test-and-Segregation Method

Another method of dealing with infected herds is to subject the entire herd to the agglutination test and segregate animals into two units occupying different premises. One unit is made up of reactors and the other of nonreactors to the test. This method often appeals to owners who find it impractical to dispose of reactors for slaughter. It can sometimes be practiced at no great additional expense to the owners, and enables them to eradicate the disease more gradually and in such a manner as not to affect profits seriously. The test-and-segregation method is especially appropriate in larger herds which have access to two or more buildings. Although the herd is separated in accordance with the results of the original test, it is necessary that the nonreacting unit be tested at intervals of from 30 to 60 days in order that subsequent reactors may be detected and promptly removed before they constitute sources of infection. A number of tests may be required to detect all the animals that harbor the germ or that acquire the disease.

Sanitary Management

Sanitary management is not very popular since it is a more or less continuous undertaking requiring both vigilance and perseverance. Although it fails to insure freedom from abortion losses it frequently accomplishes highly beneficial results.

Make frequent observations of all animals for symptoms of aborting, such as swelling of the external genitals or udder enlargement; and when such an animal is discovered place her immediately in a separate stall well away from other stock. If an abortion occurs unexpectedly, isolate the animal in the same manner as soon as the discovery is made. Bury or completely destroy the fetus and afterbirth if the latter has been expelled. Clean and apply disinfectant solutions to areas that may have been contaminated by the abortion products.

Place all pregnant animals in individual stalls a week or 10 days before calving and confine them to their calving quarters for a month following calving and as long afterwards as uterine discharges can be detected.

Clean and disinfect the maternity stalls before placing pregnant animals in them; otherwise they may constitute sources of infection. Avoid carrying germ-laden material from maternity stalls to other parts of premises on hands or clothing. The footwear of the attendant should be well scrubbed with a disinfectant solution after he has been in an infected stall.

Refrain from breeding cows for at least 2 months after calving or aborting. Bulls serving cows after such an interval should rarely if ever acquire the disease thereby or contaminate their generative organs with the causative germs.

Keep aborting animals isolated for a period of from 6 weeks to 2 months. Cows with uterine discharges should always be kept away from the rest of the herd, whether they have aborted or not, until they have recovered.

Dispose of the bedding used by infected or suspected animals in such manner as to render it inaccessible to stock that is free from the disease.

Use care in the management of the bull. Do not permit him to run with the herd or to serve cows on lots that are occupied by stock free from Bang's disease.

Vaccination

Vaccines, bacterins, and serums have been used. Abortion vaccine contains living abortion germs; abortion bacterin, the germs which have been killed; and abortion serum, the fluid portion of the blood of animals that gives a marked reaction to the abortion tests. The customary practice is to inject one of these substances beneath the skin of the animal that is to be rendered immune.

Numerous investigators who have studied the value of these substances have arrived at the conclusion that the benefit derived from the use of bacterin and serum is not sufficient to compensate for the labor and expense involved in their administration. Abortion vaccine, on the other hand, has yielded encouraging results and may have considerably practical value in combating the malady.

Reference: United States Department of Agriculture Farmers' Bulletin 1704, "Bang's Disease (Infectious Abortion)."

INFECTIOUS KERATITIS, OR PINKEYE

Inflammatory conditions of the eyes of cattle are referred to medically as ophthalmia, conjunctivitis, and keratitis, the term used depending somewhat on the parts of the eye involved or the extent of the inflammation. The common name for all of these is pinkeye.

The disease is quite widespread through the country. As with other diseases of an enzootic nature (that is, prevalent in various districts), it is difficult to explain why it becomes more widespread and virulent during certain years and in certain localities. Whether seasonal and environmental conditions may influence such outbreaks is not definitely known. Although it is apparently not confined to any particular season, the disease is rarely observed during the winter months. It affects old and young animals alike.

There are practically no fatalities from the disease, but it has an economic aspect because it results in poor condition, loss of body weight, reduction in milk secretion, and general lowering of production when a large number of animals are affected.

There is usually some general disturbance, as evidenced by a rise of temperature, partial loss of appetite, suspended rumination, decrease in the milk secretion, and indications of increasing debility in advance cases.

Treatment

In view of the probably infectious nature of the disease, when the eye infection appears in the herd all unaffected cattle should be moved promptly to other barns or pastures if this is feasible. The diseased cattle should be housed in dark stables or sheds and provided with plenty of fresh drinking water and soft, succulent feed. Depending on the size of the animal, administer 1 to 1½ pounds of Epsom salts dissolved in water.

Cocaine may be applied to the eyes when there is evidence of pain. A 1-percent solution of silver nitrate has given very good results as an eye lotion. This is applied every other day until there are definite indications of improvement, then every third or fourth day until the inflammation sub-

sides. The silver nitrate solution should be fresh when used, and may be applied to the eyes with a soft cotton swab, care being taken not to cause further irritation by undue rubbing or pressure. Less satisfactory results are obtained from applications of boracic acid solution. A more recent treatment recommended for keratitis is mercurochrome. Bardens reported having obtained very satisfactory results with mercurochrome in 1 to 4 percent solutions dropped in the eyes several times daily. The stronger solution is recommended in case of ulceration of the cornea. It is claimed to be less irritating to the eyes than the silver preparations.

Bardens also gives considerable credit to the mixed bacterins for keratitis, used simultaneously with the local mercurochrome treatment. The initial dose of the bacterin was 10 cubic centimeters, increased by 5 to 10 cubic centimeters daily until a maximum of 20 was reached. He found that two doses of bacterins were usually sufficient to correct the condition in dairy cattle.

It appears to be the consensus of opinion among veterinarians that more satisfactory results are obtained in the treatment of the disease when the mixed keratitis bacterins are used in conjunction with local treatments with the mercurochrome or silver nitrate solutions.

The treatments suggested, particularly the bacterin treatments, should be administered by a veterinarian, and, as in other infectious or contagious diseases, when an outbreak of pinkeye occurs in a herd the owner should promptly consult his local veterinarian and follow his instructions with regard to the best procedure for the eradication of the disease from the herd.

Reference: 1942 Yearbook of Agriculture, "Keeping Livestock Healthy," pages 555-559.

Parasites

Parasites, especially lice, cause considerable damage to livestock in Mississippi. Lice are so common that they are often neglected until the damage caused is very severe. It is important that lice be controlled in producing cattle; therefore, the symptoms and control measures for this parasite are presented in this publication.

CATTLE LICE

Cattle lice are widely distributed and have been recognized as a pest



Figure 26. Short-nosed cattle louse, female (Magnified about 20 times).



Figure 27. Long-nosed cattle louse, female (Magnified about 20 times).

by livestock growers for a considerable period of time. Cattle lice are injurious to all classes of cattle, occurring most frequently on young stock and on poorly undernourished old cattle. Losses are caused by irritation, digestive disturbance, stunted growth, low vitality, and increased death rate.

Ordinarily lice on cattle are not observed until they have become so numerous that they cause unmistakable signs of annoyance. Usually the animals whose lousy condition first attracts attention are

the poor, sick, unthrifty members of the herd, and frequently the owner thinks they are lousy because they are unthrifty, whereas the unthrifty condition may be caused by the lice.

Three kinds or species of lice are commonly found on cattle in the United States. Two of these are blood sucking or sucking lice and are commonly known as blue lice. The third species is biting louse, commonly known as "little red lice."

Suctorial Lice

There are two species of sucking lice. They are the short-nosed and long-nosed cattle lice. The short-nosed cattle lice are usually found on mature cattle while the long-nosed cattle lice are usually found on calves and young stock. The sucking lice are illustrated in figures 26 and 27.

Biting Lice

Biting lice are found on both young and mature cattle and are much smaller than the sucking lice. This type of lice is illustrated in figure 28.

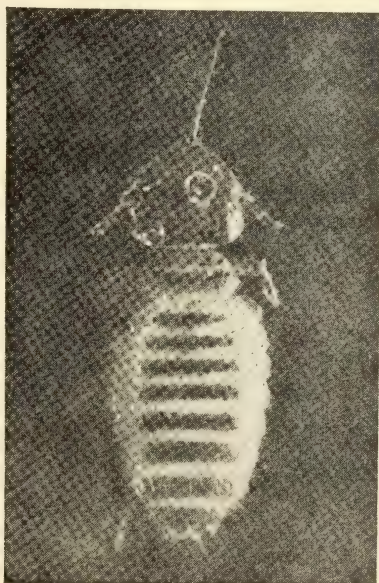


Figure 28. A biting louse.

Nature and Habits

Lice increase very rapidly in number on cattle during dry, cold weather when the hair is long, but when green feeds come in the spring and the animals shed the old coat of hair the lice become less numerous. Some of the lice, however, usually remain on the animals throughout the summer, but not in sufficient numbers to do harm. Treatment, therefore, should be applied in the fall while the weather is suitable and before the lice have become numerous enough to cause injury. On animals that are not treated in fall, treatment should be applied as quickly as the weather will permit in the spring.

Method of Treatment

There are three commonly used methods of applying treatment for lice: (1) hand application, (2) spraying, and (3) dipping. The best method to adopt depends on the season of the year, the remedy selected, the number of cattle to be treated, and the facilities available. In Mississippi, by selecting warm periods in which to apply treatments, any one of the three methods mentioned can be used without injury to the cattle.

Hand Applications

Hand applications may be used successfully in treating small numbers of cattle for lice. Hand application of (1) dusting powders; Derris dust has been used successfully in controlling lice; (2) greases and liquids; the following remedies have proved effective when applied by hand and the treatment repeated if necessary in about 16 days, (a) cottonseed oil and kerosene, equal parts, (b) kerosene and lard mixed in the proportion of $\frac{1}{2}$ pint kerosene to 1 pound lard, (c) crude petroleum, and (d) any of the dips recommended for use in dipping; (3) spraying; where an orchard spraying outfit is available, it may be used in treating animals for lice. Any of the dips recommended may be applied in the form of a spray. Two treatments should be given 15 to 16 days apart. When the arsenical dip is used, care should be taken to see that neither the cattle nor the operator breathes the spray. The operator should also be careful not to get clothing wet with the dip.

Dipping

Dipping is the most satisfactory method of treating cattle for lice. All of the cattle in the herd should be dipped twice at 15- to 16-day intervals. The following mixtures have been used successfully in treating cattle for lice.

Arsenical Dip

- 4 pounds caustic soda (85 percent pure).
- 8 pounds white arsenic (99 percent pure), in fine powder.
- 8 pounds sal soda crystals.
- 1 gallon pine tar.
- Water sufficient to make 500 gallons.

Coal Tar Creosote Dips

The coal tar creosote dips are sold under many trade names. They are made from coal tar derivatives and the principal ingredient is creosote oil which is made soluble in water by means of soap. The coal tar creosote dip should be used in accordance with instructions printed on the label of the container.

Reference: United States Department of Agriculture Farmers' Bulletin 909, "Cattle Lice and How to Eradicate Them."

SWEET POTATO PRODUCTION

TIME OF PLANTING
AND HILL SPACING
STUDIES

AGRICULTURAL EXPERIMENT STATION
MISSISSIPPI STATE COLLEGE

CLARENCE DORMAN, DIRECTOR
STATE COLLEGE MISSISSIPPI

SUMMARY AND RECOMMENDATIONS

1. Delaying the time of planting and widening the hill spacing, in general, caused the total and No. 1 yields to be gradually reduced.

Porto Rico planted the middle of April yielded 33 bushels total and 13 bushels No. 1 more than when planted the second week of May. This delay with Triumph caused a loss of 98 bushels total yield. When Porto Rico was planted about June 1, 152 bushels total and 91 bushels No. 1 less than the April planting were made.

Triumph planted June 1 made 151 bushels total yield less than the April planting. If Porto Ricos were not planted until the last of June or the first of July a loss of 177 bushels total and 118 bushels No. 1 resulted, as compared to the April planting. If Triumph was planted the last half of June, 189 bushels less total yield was made than the April planting, and another delay to the first half of July gave 252 bushels, less than the April planting.

2. Widening the hill spacing from 8 to 42 inches had a less effect upon total and No. 1 yield than did delaying the planting, and spacing had a lesser effect upon yields at plantings from April 15 to May 15 than at later plantings. Spacing did not greatly affect yield unless the hills were wider than 24 inches.

3. Estimated net profits per acre were reduced as the time of planting was delayed and as the spacing was widened beyond 24 inches, assuming mule or tractor equipment methods.

4. The highest total yield of Triumph and the greatest net profit per acre came from the April planting and spacings of 16 to 24 inches.

5. The highest yield of No. 1 Porto Rico and the greatest net profit per acre came from the April planting and the 16-inch spacing.

6. The greatest yield of Triumph per man hour and the highest return in money per man hour came from the April planting and 24-inch spacing with mule equipment and 32-inch spacing with tractor equipment. There was not a great difference between the 16-, 24-, and 32-inch spacings.

7. Sweetpotatoes should be planted as early as plants are available after the average frost-free date.

8. The Porto Rico variety grown for food use should be spaced approximately 12 to 16 inches apart. The Triumph for starch or feed should be spaced approximately 24 inches when planted by the middle of May and approximately 16 inches when planted after May 15.

Sweetpotato Production

Time of Planting and Hill Spacing Studies

By W. S. ANDERSON and JOHN W. RANDOLPH*

Growing sweetpotatoes for food and for industrial utilization is an agricultural enterprise of increasing importance throughout the South. In Mississippi the sweetpotato has for many years ranked high as a food crop grown for home use and for marketing. Because of its ready adaptability to certain processing requirements and its high essential food value as compared to many other foods, the sweetpotato has acquired new and added national prominence during the war emergency.

Importance of Sweetpotatoes

In the South at least, the sweetpotato exceeds all other crops in potential carbohydrate production per acre. Attesting to this importance is the fact that for 1943 a goal of 1,000,000 acres has been set for the country as a whole, and in Mississippi, farmers are being asked to plant 95,000 acres, which is 15,000 acres more than the average planted in the period of 1929-38, and 27,000 acres more than were planted in 1941.

Sweetpotato starch manufacture is an infant industry in this country, there being yet only one plant in operation. It is important to Mississippi that this first plant, an experimental one at first and somewhat still so, was located in this State. Many problems of manufacture have been solved, others are yet to be solved; and many problems of producing the raw material had to be attacked at the start of the enterprise.

Cooperative Experiments

The Mississippi Experiment Station, in cooperation with the Laurel Starch Plant, a farmers' cooperative, and other agencies, has been actively engaged since 1934 in a varied and rather comprehensive program of research with these production

problems. Work has been carried on investigating almost all phases of production, ranging from propagation problems to storage studies. Specifically, these experiments have dealt with sprouting, seed size, sprout size, varieties, fertilizer, spacing, time of planting, time of harvesting, tillage, transplanting, harvesting, and storing. While some of this work has been done at State College and the various branch stations, the major portion of it has been carried on in the vicinity of Laurel, Mississippi, and usually in close cooperation with growers of the area.

It is the purpose of this bulletin to report on only those experiments designed to study the effect on sweetpotato production of varying the time of planting in the field at various distances in the row. This work has been done by the cooperation of the Divisions of Fruit and Vegetable Crops and Diseases and of Farm Mechanical Equipment of the Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture, Agricultural Research Administration, with the Mississippi Station. These experiments were done essentially similar to experiments carried on under a cooperative arrangement with the Bureau in three other southern states, namely, Georgia, South Carolina, and Texas. Detailed results of these cooperative experiments are being prepared for publication elsewhere.

Growers of sweetpotatoes for food in the unprocessed form are anxious to produce the greatest yield per acre of saleable grades, usually including U. S. No. 1 and No. 2 grades, but they are also interested in having as few as possible of the unmarketable strings and oversized roots. If it is feasible to feed these unmarketable sizes to livestock, this portion

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of the crop may not be a total loss. The grower of sweetpotatoes for starch making is primarily interested in total yield, for any size which can be handled by the factory methods of mechanical conveying and washing, and grinding, may be sold at the contract price.

Soils, Fertilizers, Spacing, Planting Dates Used In Experiment

These experiments were carried on during the years 1940, 1941, and 1942. In each year the plots were located on different sites, and on different farms in the vicinity of Laurel.

Three Soils Used

Thus in 1940 they were located on a field of fertile terrace soil classified as Cahaba fine sandy loam, which, although it had been in continuous cultivation for 40 years, was fertile enough to produce more than a bale of cotton to the acre in 1939. In 1941 the plots were located on a field of second bottom or terrace soil, classified as Kalmia fine sandy loam, which had not grown cultivated crops for several years. It had been cleared, tile drained, and intensively cropped for a few years, 10 or 15 years previously. This soil can be classed as poor, for it contained only traces of the various major plant nutrients according to laboratory analysis. In 1942 the plots were located on an upland soil classified as Ruston fine sandy loam, which contained considerable organic matter and which had not been cultivated for 3 previous years. All 3 years the experiments were on soils representative of a large portion of the tillable land in South Mississippi.

Each year the plots were fertilized with 1100 pounds to the acre of a 6-8-8 fertilizer, applied in the furrow 10 days before planting in 1940, but side-placed in 1941 and 1942, 800 pounds on the day of planting and 300 pounds 3 weeks after planting.

Planting Dates, Spacings

Plantings of each of 8-, 12-, 16-, 24-,

32-, and 42-inch spacings were made at each of five times, beginning about the time thought to be the earliest frost-free date and continuing at 16- to 21-day equal intervals. In 1940 the first planting was made on April 1, but a frost on April 6 killed the plants, so the planting was remade on April 24, and succeeding plantings were made 16 days apart with the last being made on June 27. In 1941 the first planting was made April 15, and the succeeding plantings were made at 19-day intervals with the fifth being made July 12. In 1942 planting was started on April 25, and the others followed at 21-day intervals with the fifth being on July 14.

Weather Conditions

Weather conditions, especially rainfall, influence significantly the stand and "growing-off" of sweetpotatoes. For that reason data from U. S. Weather Bureau records for 1940 and 1941 and from station staff observations in 1942, for the period of March 1 to September 30 and the average of 1902-41 are presented in table 1. Because the time rain occurs in relation to the time of transplanting is of importance, data are presented in table 2 which show the occurrence of rains by dates in the 3 years during the planting period. Weather Bureau data show that the average last killing frost date at Laurel is March 19; and the latest date recorded is April 25. The average length of the growing season is 234 days. These data may help in interpreting certain otherwise unexplainable differences in performance of certain of the times of planting treatments.

Sweetpotato Varieties Used

Both the Triumph and the Porto Rico (Unit 1 strain) varieties were planted at each time and at each spacing, arrangements of plots being such as to give five repetitions in each year of each single treatment. The plants were set carefully by use of trowels, and usually watered to insure promptly a good stand on each plot. The trowel method of transplant-

Table 1. Inches rainfall at Laurel and Ellisville, Mississippi, during specified months of 1940, 1941, 1942, and the average.

Year	March	April	May	June	July	August	September
1940	4.08	10.62	0.72	10.47	9.97	1.34	2.72
1941	8.31	2.85	0.47	6.14	14.89	2.27	2.58
1942*	9.50	1.73	2.32	8.66	4.31	8.29	5.60
Average 1902-41	5.82	5.07	4.61	4.64	5.93	4.34	3.42

*Ellisville Station data except March from Laurel, U. S. Weather Bureau data.

Table 2. Dates of occurrence of rains of approximately one-half inch or more during planting period 1940-41-42.

Inches rainfall in					
1940		1941		1942	
April 7	0.71	April 21	0.72	April 9	1.52
April 11	1.71	April 24	1.29	April 12	0.52
April 18	2.00	May	None	May 14	1.61
April 30	5.20	June 12	1.01	June 4	0.48
May 1	0.58	June 14	1.16	June 6	1.86
June 7	0.52	June 17	1.29	June 21	0.60
June 9	0.83	June 19	0.78	June 22	4.10
June 11	0.95	June 27	0.87	June 30	0.50
June 14	0.59	July 4	0.88	July 7	2.09
June 29	5.00	July 5	1.12	July 23	0.48
July 3	3.25	July 6	4.48	July 25	1.25
July 6	1.30	July 9	2.35		
July 8	1.15	July 25	1.68		
July 10	0.63				

ing has been found to give near perfect stands, necessary in an experiment of this type. In actual practice the farmer following hand methods uses a stick for forcing the plants into a loose-worked seedbed. The labor and cost analysis of the reported experimental data is based upon the stick-hand method and the use of mechanical transplanter.

Later Plantings, Wider Spacings, Result In Lower Yields

Since these experiments were planted on three different soils in the 3 years, data on average yields of all spacings for each year are presented in table 3. These data show that in some cases the times of planting and spacings yielded differently in different years. This is due to the different soils and weather conditions, particularly rainfall.

The time of planting has by far the greatest effect upon total yields of both varieties. It is important to note that in

most cases, whether in different time of planting or hill spacing, the Triumph outyielded the Porto Rico variety. The most difference between varieties in any one year was in the yield of the third planting in 1942, when the Triumph more than doubled the Porto Rico at all spacings.

Effect of Rainfall

In general, the data show that the later the planting and the wider the spacing the lower was the yield, with the exception that the third planting yielded lower than the fourth in many instances.

In 1940 the third planting was made on May 27, and from table 2 it is seen that no rain of value occurred between May 1 and June 7. The plants lived but did not grow any until after the rain of June 11. In 1941 the third planting was made May 29, and no rain of consequence occurred between April 24 and June 12, yet better yields were made on most spacings at that planting in 1941 than in the other years. This was due

Table 3. Average total yields in bushels per acre from different times of planting and spacing, 1940, 1941, and 1942.

Porto Rico																				
Planting times	8-inch spacing			12-inch spacing			16-inch spacing			24-inch spacing			32-inch spacing			42-inch spacing				
	1940	1941	1942	1940	1941	1942	1940	1941	1942	1940	1941	1942	1940	1941	1942	1940	1941	1942		
1st	224	240	311	202	231	283	234	250	295	176	274	314	185	231	287	148	238	209		
2nd	181	219	279	190	238	225	152	226	225	166	225	307	144	196	248	121	197	196		
3rd	127	120	24	141	117	43	113	115	40	125	129	40	119	116	42	85	107	29		
4th	186	117	107	182	144	199	188	110	88	122	74	70	105	94	81	108	85	86		
5th	130	63	32	97	77	34	101	67	29	90	66	25	71	47	24	69	92	23		
Triumph																				
1st	382	454	302	352	502	332	359	451	318	348	416	289	317	388	284	272	352	271		
2nd	282	363	247	271	369	265	257	307	225	199	305	204	199	293	161	169	325	167		
3rd	252	275	174	272	259	163	274	276	177	210	217	114	217	223	108	208	216	89		
4th	283	137	158	303	118	154	226	119	127	248	125	117	195	113	111	205	118	114		
5th	180	129	71	164	96	59	162	100	67	139	107	52	144	111	35	120	84	38		
3-year average of all plantings and both varieties												at specified spacings								
1940	272			272			256			229			214			195				
1941	276			269			250			234			206			219				
1942	171			176			159			153			138			122				

undoubtedly to the fact that the 1941 plots were on a field of bottom soil, retentive of moisture. In 1942 the third planting was made June 4, and no rain of consequence had occurred since May 14. A shower came on the day of this planting, but the soil was very hot and dry, and even though a good rain fell 2 days later, the plants had been so badly damaged that they did not grow for some time.

Effect of Planting Date

In table 4 are shown the average total yields of all grades for each variety for

3 years from each time of planting and spacing, and the space and time averages for each variety. These data show that the two varieties can be expected to yield about alike under various times of planting practices; that is, with both varieties, delaying the planting caused decreases in total yield in about the same way.

Thus, the average data for Porto Rico show that delaying planting 3 weeks after April 15 to 25, caused a loss of 33 bushels. Delaying it another 3 weeks resulted in a loss of 119 bushels; but another 3 weeks delay, in a period of ample rain-

Table 4. Average of 3-year total yields in bushels to the acre of sweetpotatoes planted at different times and hill spacings.

Porto Rico							
Planting times	8-inch spacing	12-inch spacing	16-inch spacing	24-inch spacing	32-inch spacing	42-inch spacing	Time average
April 15-25	258	239	259	254	234	198	240
May 8-14	226	218	201	233	196	171	207
May 27-June 4	90	100	89	84	92	74	88
June 14-23	137	175	129	89	93	93	119
June 28-July 13	75	69	66	60	47	61	63
Space averages	157	160	149	146	132	119	
Triumph							
April 15-25	379	395	376	351	329	298	354
May 8-14	297	302	263	236	218	220	256
May 24-June 4	234	231	242	180	183	171	203
June 14-23	193	192	157	163	139	146	165
June 28-July 13	123	106	109	99	97	80	102
Space averages	245	244	232	201	193	175	

fall, resulted in an increase of 31 bushels average yield. Another delay of 3 weeks caused another decrease of 56 bushels in total yields.

In the case of the Triumph a loss of 98 bushels resulted from delaying planting 3 weeks after April 15 to 25. A loss of 53 bushels resulted from another delay of 3 weeks, 42 for the next, and 38 bushels for the next delay of 3 weeks.

All of these losses in yield from delaying the planting are large enough to indicate that low cost sweetpotato production depends upon having an early supply of planting material, produced efficiently in a hot bed. Other studies proved that for the Laurel area, cold frame or field bed plant production resulted in plants too late for profitable yields.

Effect of Plant Spacing

The data in table 4 also show that the two varieties responded about alike in regard to the effects upon total yield of the various hill spacings. The space averages for both Porto Rico and Triumph show that there was a loss in yield by widening the spacing from 12 to 16 inches, from 24 to 42 inches, and from 32 to 42 inches.

Effect on No. 1 Grade

Because the Porto Rico variety is grown for food and the number 1 grade produced by any practice is important, table 5 is presented to show how the yield of this grade was affected by time of planting and spacing in each of the years. Table 6 presents the 3-year time and space average. All the data show that there was considerable variation in production of No. 1 grade in the different years, but in general the earlier plantings and the closer spacings produced the most bushels of No. 1 grade.

These data show that the widening of spacing from 8 to 12 inches, averaging all planting times, resulted in a loss of 10 bushels. Widening the spacing from 12 to 24 inches gave another 10-bushel reduction in yield. In widening spacing

from 12 to 24 inches, production of No. 1 grade dropped 21 bushels.

As has been pointed out, the delaying of planting has a greater effect upon yield of No. 1 and total yield than changes in hill spacing. Thus, from the table it is seen that delaying planting 3 weeks after the middle of April causes a loss of 23 bushels of No. 1 Porto Ricos, and delaying it another 3 weeks results in another loss of 68 bushels. Both of these losses are great enough to be of much significance to growers of No. 1 sweetpotatoes. The fourth planting, ranging from June 14 to 23, actually produced an average of 9 bushels more No. 1's than the planting 3 weeks earlier. The loss of 36 bushels of No. 1's shown by the delay of planting from the period of June 14-23 to that of June 28-July 13 is highly important.

Cost and Profit Studies Applied to Mule and Machine Methods

War conditions have made the public extremely conscious of farm production, costs, and labor efficiency. The yield data from these experiments permit an application of results from other sweetpotato production studies carried on by the cooperation of the Division of Farm Mechanical Equipment of the Bureau mentioned above. In this bulletin only those results obtained in Mississippi and their interpretation in the light of Mississippi conditions have been attempted. These yield data will now be translated by calculations into grower profits, based on certain specified costs incident to and labor required for the production of the crop by each of two more or less common practices with respect to mechanical equipment, namely, mule-drawn equipment and one-row tractor equipment.

Production Factors Considered

In normal times a farmer can generally increase his use of production facilities to obtain economies in his farm operation. However, with war conditions there

are definite restrictions on labor, power, fertilizer, and equipment. These restrictions are further complicated because most of the farmer's work has to be done in limited periods which may be shortened by unfavorable weather conditions.

In analyzing the data from these experiments from the standpoint of profits to growers, certain assumptions had to be made. Land rent was charged at \$3.65, the rate shown to prevail in the area by Guin and Parvin in Mississippi Experiment Station Bulletin 352. Fertilizer cost of \$18.50 was considered at 1943 prices and at a rate of 1100 pounds to the acre, because that is the rate applied to these experiments. Other costs including dipping chemicals for seed potatoes, and inspection fees necessary for State Plant Board certification brought the total of standardized costs to \$22.37 an acre.

Sweetpotato Farm Practices

Local good farm practices have been assumed for all field work. With mule equipment it has been assumed that hand transplanting would be practiced, and because moisture is usually ample at the time, no watering is charged for the first and fourth plantings. Three cultivations are assumed for the first, second, and third plantings, two for the fourth planting, and one for the fifth. Two hoeings are considered necessary for the first and second plantings, three for the third, and one each for the fourth and fifth plantings. Three hoeings are considered necessary for the third planting because, due to dry weather the plants do not grow off fast enough for the vines to shade out grass and weeds. Uniform hoe work charges are considered for the various

spacings, with both mule- and tractor-equipment methods.

Seedbed preparation varies and the cost is increased at the later plantings because the land must be re-worked more times than for the early planted crop. It is realized, however, that many growers who may practice late planting will grow an early summer harvested vegetable or small grain crop on the land before sweetpotatoes are planted. In such cases the extra land preparation cost for late planting would not be chargeable to sweetpotatoes.

Machine and Transplanting Costs

Machine charges are based upon data published in a report by a committee of the American Society of Agricultural Engineers on Farm Machinery Rental Schedules, in *Agricultural Engineering*, Vol. 24, No. 1, January 1943. The estimated costs are all based on the time actually required for the average machines and men to do the various jobs, as determined by careful checking of Station crews and farmer operations.

Transplanting cost varies with the spacing, and this is taken into consideration in the calculations. Machine planting and watering involves hauling water, plants, and fertilizer to the field; filling transplanter tank and fertilizer hopper, and arranging plants on machine.

Sweetpotato Plant Costs

One of the most expensive items in sweetpotato production is plant cost. In this bulletin the cost of plants has been based upon unpublished data from a study to determine the 1942 value. Extremely wide variations in plant produc-

Table 6. Three-year average yields of No. 1 grade of Porto Rico sweetpotatoes, bushels to the acre.

Planting time	8-inch spacing	12-inch spacing	16-inch spacing	24-inch spacing	32-inch spacing	42-inch spacing	Time average
April 15-25	187	154	161	156	129	115	150
May 8-14	156	145	127	129	116	91	127
May 27-June 4	70	65	55	59	66	42	59
June 14-23	80	84	85	52	55	53	68
June 28-July 13	38	33	33	33	33	26	32
Space average	106	96	92	86	79	65	

Table 7. Man hours required to grow and pull sweetpotato plants, adjusted to six plant spacings and five planting times

	8-inch spacing	12-inch spacing	16-inch spacing	24-inch spacing	32-inch spacing	42-inch spacing
Plants per acre	18,668	12,446	9,334	6,223	4,667	3,556
Planting times	Man hours per acre to grow and pull plants					
April 15-25	53.2	35.5	26.6	17.7	13.3	10.1
May 8-14	50.2	33.5	25.1	16.7	12.5	9.6
May 28-June 4	37.0	24.6	18.5	12.3	9.2	7.0
June 14-23	33.5	23.0	16.8	11.5	8.4	6.2
June 28-July 13	25.6	17.1	12.8	8.5	6.4	4.6

tion were found from farm to farm. Hence a limited amount of plant production costs data, collected from the most efficient farmers, was used in the final evaluations. These costs were used in an analysis of plant production as reported in table 6 of Mississippi Experiment Station Bulletin 349. Assuming that good seed stock is bedded, yielding approximately as many plants to the bushel as were obtained from the "carefully" handled lot reported and assuming the use of the two-ditch type of fire heated beds, water when needed, fertilizing, and pulling, plants for 1942 would cost approximately as follows:

April 1 to April 25\$1.75 a thousand
 May 5 to May 15\$1.53 a thousand
 May 25 to June 4\$1.10 a thousand
 June 14 to June 24\$1.04 a thousand
 July\$0.66 a thousand

Table 7 shows the average number of man hours per acre, with different plant distributions, required to build a hotbed (annual costs assuming the bed would be used for 3 years), to bed and cover the sweetpotatoes, to care for the bed by heating, watering, and adjusting the covers, and to pull and pack the plants ready to go to the field. It must be considered in later discussion that plant production makes up a large part of the total labor requirements of the crop.

Labor Costs and Methods

All field labor costs have been figured at 40 cents an hour for tractor drivers and farm operators (in case of mule farm) and 20 cents an hour for other labor and for mules. Certain costs are the same re-

gardless of spacing, time of planting, yield, or methods of growing sweetpotatoes.

In calculating harvesting costs of starch potatoes it has been assumed that under the mule-equipment methods, the growers will use the heap-row and bagging procedure after digging with a middle-buster equipped with a small diameter shielded rolling coulter off-set to prevent serious cutting of the roots. The time required for any method of harvesting varies with the yield, but to a considerable extent with the class of labor. These variables have been taken into account in developing the cost of harvest figures used in this bulletin.

The tractor equipment method as reported has had limited acceptance because of its newness. The sweetpotato row was prepared for digging by cutting the vines and plowing them into the row middles with disc hillers mounted in a cultivator frame on the tractor which pulled a rod link mechanical digger. In harvesting starch sweetpotatoes three pairs of disc hillers set in a A pattern were used to clean all vines from the row. When the crop required crating and storage, only one pair of hillers was used to cut the vines at the edges of the cutting blade of the digger. Cost of gathering starch potatoes was based upon field collecting in field crates which are used to loose-load the body of a dump truck.

The costs of gathering and crating the Porto Rico sweetpotatoes for storage were based upon the field selection of the sound No. 1's and then using the

starch potato method for gathering the balance of the crop.

Value of Sweetpotatoes

In calculating the data of these experiments to net profits per acre, it was necessary to assume definite value for the crop. The Triumph variety has been figured at 35 cents a 60-pound bushel for all grades, because this was the price paid to starch sweetpotato growers in 1942. Hauling has been figured at 1942 prevailing rates. In the calculations on the Porto Rico variety, it has been assumed that the No. 1 grade could be marketed at an average price of \$1.00 per 60-pound bushel. The other grades have been considered as "starch potatoes." If the No. 1 grade of Porto Rico is cured and stored for marketing later than at harvest time, an additional cost item, varying with conditions but averaging about 15 cents a bushel, would need to be taken into account. The calculations in this bulletin assume only delivery of the crop to the storage house.

The cost of transplanting varies with the methods employed and with the hill spacing. To show this variation in costs, data for the work of hand and machine transplanting are shown in table 8. These data show that 19.6 hours per acre are used in watering 8-inch spaced hand transplanted plants. The difference contributed to the job of watering is 17.3 hours at 12-inch spacing, 14.0 hours at 16-inch, 10.8 hours at 24-inch, 9.6 hours at 32-inch, and 8.2 hours at 42-inch spacing. Likewise, mule costs are higher, even more than doubled in some cases, by the requirement of watering, because the water must be hauled to the field. Because of these inconveniences in watering most growers prefer to await a rain before setting their fields; frequently this waiting for rains causes too much delay for the production of good yields.

The data in table 8 show significant differences in man labor required for setting with machines as compared to hand setting. In view of the scarcity of

Table 8. Time required and costs of transplanting an acre of sweetpotatoes by hand and by machine methods

Item	Hill spacing in inches					
	8-inch spacing	12-inch spacing	16-inch spacing	24-inch spacing	32-inch spacing	42-inch spacing
Hand transplanting without watering						
Man hours	38.4	29.5	24.5	19.9	17.2	14.6
Costs (1 at 40c, 2 at 20c)	\$10.22	\$7.84	\$6.51	\$5.31	\$4.58	\$3.88
Mule costs at 20c	0.36	0.32	0.28	0.24	0.20	0.16
Equipment	0.43	0.43	0.43	0.42	0.42	0.42
Totals	\$11.01	\$8.59	\$7.22	\$5.97	\$5.20	\$4.46
Hand transplanting with watering						
Man hours	58.0	46.8	38.5	30.7	26.8	22.8
Costs (1 at 40c, 2 at 20c)	\$15.43	\$12.45	\$10.24	\$8.16	\$7.12	\$6.03
Mule costs at 20c	1.08	0.86	0.64	0.51	0.43	0.36
Equipment	0.51	0.48	0.46	0.45	0.44	0.44
Totals	\$17.02	\$13.79	\$11.34	\$9.12	\$7.99	\$6.83
Machine transplanting with watering						
Man hours	21.5	16.6	13.0	9.1	7.4	6.0
Labor cost (1 at 40c, 3 at 20c)	\$5.39	\$4.15	\$3.25	\$2.28	\$1.85	\$1.50
Tractor hours	8.7	6.6	5.0	3.5	2.6	2.2
Fuel costs	\$1.48	\$1.12	\$0.85	\$0.59	\$0.44	\$0.37
Equipment	\$4.26	\$3.23	\$2.45	\$1.72	\$1.27	\$1.08
Water and other equipment	0.82	0.78	0.76	0.68	0.63	0.60
Totals	\$11.95	\$9.28	\$7.31	\$5.27	\$4.19	\$3.55

labor on farms the difference, for example, between 58.0 hours required by the hand method and 21.5 man hours required per acre for an 8-inch spaced acre by the machine method is an important saving for watered plants. The total cost estimated for hand planting without water does not differ by an important amount from machine transplanting with water.

The differences in labor required in any method for setting plants at various hill differences is also striking. Approximately half as much labor is required for the 24-inch spacing as for the 8-inch spacing.

Tillage Operation Costs

In table 9 are presented data on the time

required and costs involved in various tillage operations of producing sweetpotatoes by each the mule-equipment and the tractor-equipment methods. These data show that more time is required for seedbed preparation but that less work of cultivation is required for the later plantings. Plants set in June, because of the rainfall and higher temperature, grow off faster than earlier plantings, thus covering the land more quickly and shading out weeds and grass.

Harvesting Costs

The data in table 10 show the time required and the costs involved for the various operations of harvesting sweetpotatoes. It is seen by the data that the total fixed costs of digging with tractor and

Table 10. Time required and costs to the acre involved in harvesting sweetpotatoes, by mule and tractor equipment methods.

Digging: Middle-buster with coulter						
	Hours man	Hours mule	Value of labor	Value of power	Machine costs	Total costs
All planting times ..	2.03	4.06	\$0.81	\$0.81	\$0.06	\$1.68
Digging: tractor and mechanical digger						
	Hours man	Hours tractor	Value of labor	Fuel etc.	Machine costs	Total costs
All planting times...	2.2	2.2	\$0.88	\$0.55	\$1.65	\$3.08
	2.2	—	0.44			0.44
						\$3.52
Gathering certain yields, tractor and mule methods of digging						
Yield per acre	Middle-buster digging			Mechanical digging		
	Man hours per acre	Charges for bags		Man hours per acre	Charges for field crates	
Starch sweetpotatoes						
100	43.2	\$1.40		14.8	\$1.20	
200	58.8	1.70		20.0	1.60	
300	67.7	1.90		26.3	2.00	
No. 1 Porto Rico sweetpotatoes						
100	29.8			23.8		
200	41.9			38.0		
Culls Porto Rico sweetpotatoes after No. 1's are picked up						
100	20.2	1.40		16.8	1.20	
200	26.4	1.70		21.9	1.60	
Hauling to factory or storage, tractor and mule methods of digging						
	Costs per ton for hauling with					
	Bags on flat bed truck	Crates in stake body truck	Loose sweetpotatoes in dump truck			
From Middle-buster digging	1.25	\$1.50				
From mechanical digging		1.50			\$1.00	

a mechanical digger are about double the costs of mule and middlebuster digging. This is due to the relatively large machine costs necessary for the tractor and digger equipment. The table shows that as the yield increases the man hours and the costs increase, but not in the same proportion. High yields of sweetpotatoes are picked up, bagged, or crated much more efficiently than low yields. The man hours required for gathering mechanically dug crops are much less than for equal yields of middlebuster dug crops.

PRODUCTION PROFITS UNDER TRACTOR EQUIPMENT METHODS

In table 11 data are presented to show the profits calculated from yields of the three years of these experiments for tractor equipment methods of growing sweetpotatoes by various planting times and hill spacings.

Analyzing the experiment as a whole, much difference occurred between years in possible profits. It has already been pointed out that the yields between the years varied, and it should be expected that calculated profits would vary in about a similar manner. Taking the experiment as a whole, it can be seen also that the expected profits from growing the Porto Rico are greater in every case than from the Triumph. This should be true because of the assumed higher

price for the No. 1 grade of Porto Rico. It should be emphasized, too, that in these calculations it has been assumed that growers would market all of the yield of jumbo, No. 2, and cull grades from the Porto Rico variety at starch factory prices and costs. That is, in studying these data for any comparison it must be kept in mind that the maximum return possible with the assumed prices has been considered in making the calculations of profits.

Early Plantings Most Profitable

Under the assumed tractor-equipment methods of production, the average profits from the various times of planting varied in about the same way for each variety. Thus, with Porto Rico the average of the first planting time was \$114.15 profit, for the second \$80.11 profit, for the third \$0.61 loss, for the fourth \$17.84 profit, and from the fifth \$19.16 loss. In the case of Triumph for starch, the first planting averaged \$41.97 profit, the second \$16.89 profit, the third \$4.14 profit, the fourth \$4.39 loss, and the fifth \$23.36 loss.

Hence, in general, considering all spacings together, it can be said that the profits were lower as the planting was delayed with both varieties, the only exception being in the fourth planting of Porto Rico, which showed a significantly greater profit than the third planting.

Table 11. Calculated profits to the acre from growing sweetpotatoes by various planting times and hill spacings, using tractor equipment; average from yields of 1940, 1941, and 1942.

Planting times	Dollars to the acre profit at hill spacing shown						
	8-inch	12-inch	16-inch	24-inch	32-inch	42-inch	Average
Porto Rico							
April 15-25	\$113.76	\$96.34	\$169.93	\$124.69	\$98.73	\$81.35	\$114.15
May 8-14	86.45	89.58	78.81	93.43	76.94	55.46	80.11
May 27-June 4	-14.10	6.73	-0.47	3.66	10.08	-9.55	-0.61
June 14-23	15.98	33.07	30.29	9.74	6.35	11.61	17.84
June 28-July 13	-14.96	-23.50	-19.42	-16.94	-22.19	-17.98	-19.16
Triumph							
April 15-25	\$27.10	\$44.75	\$47.03	\$47.59	\$45.39	\$40.08	\$41.97
May 8-14	7.76	21.27	17.84	19.61	16.26	18.61	16.89
May 27-June 4	-6.64	2.84	14.86	2.55	8.71	2.50	4.14
June 14-23	-13.61	-3.64	-8.57	-0.60	-4.99	-0.94	-4.39
June 28-July 13	-29.06	-28.37	-20.63	-21.00	-18.69	-22.42	-23.36

At any one hill spacing the profit was also reduced or loss was incurred by delaying planting, except that there was a greater profit from the fourth than from the third with all spacings of Porto Rico. The fifth time of planting resulted in losses at all spacings with Porto Rico and Triumph.

With the Triumph the data show that losses are expected to occur from all spacings at the fourth planting time, the period of June 14 to 23. At the 8-inch spacing no profit could be expected after the second planting, May 8 to 14, with Triumph grown for starch. Some profit is indicated for the third and fourth plantings of Triumph at all other spacings. Profit was greatest at 16-inch spacing, but this profit was not significantly greater than at the other spacings.

16-inch Spacing for Porto Rico

At the first planting Porto Rico gave the greatest profit at 16-inch spacing, while the 24-inch spacing gave the second greatest profit. At the second planting the greatest profit came from 24-inch spacing, but this spacing did not exceed by large amount any other spacing except the 42-inch. At the fourth planting the greatest profit came from 12-inch spacing, but it was almost identical with that of the 16-inch.

12- to 32-inch Spacing for Triumph

At the first planting time Triumph, if

grown for starch, should give the greatest profit at any spacing from 12 to 32 inches, the data showing very small differences between any two of these spacings; the 8- and 42-inch spacings showed considerably lower profits. At the second planting also there are small differences in the profits from the various spacings. They are some lower at the 8-inch.

PRODUCTION PROFITS UNDER MULE-DRAWN EQUIPMENT METHODS

The data in table 12 are presented to show the profits calculated for mule equipment methods of growing sweetpotatoes, using the 3-year yield data for the various planting times and hill spacings.

These data show that, taking the experiment as a whole, time of planting greatly affects profits with mule-equipment methods. As was the case with profits calculated for tractor-equipment methods, and for the same reasons, greater profits are shown for the Porto Rico than for the Triumph variety.

Time of Planting Most Important

Spacing of the hills greatly influenced profits. Time of planting is more important in profits than spacing. Thus the average of all spacings of Porto Rico shows a profit from the April 15 to 25 planting time of \$101.15 to the acre,

Table 12.—Calculated profits to the acre from growing sweetpotatoes by various planting times and hill spacings, using mule equipment; average from yields of 1940, 1941, and 1942.

Planting times	Dollars to the acre profit at hill spacing shown						
	8-inch	12-inch	16-inch	24-inch	32-inch	42-inch	Average
Porto Rico							
April 15-25	\$109.63	\$92.43	\$110.98	\$113.95	\$98.75	\$81.18	\$101.15
May 8-14	78.02	75.61	74.26	84.28	72.98	46.19	71.89
May 27-June 4	-26.97	-7.53	-11.62	1.20	4.01	-12.07	-8.83
June 14-23	18.63	34.94	29.99	2.05	8.44	10.74	17.46
June 28-July 13	-26.48	-29.49	-24.46	-17.94	-27.42	-26.72	-25.42
Triumph							
April 15-25	\$14.16	\$31.28	\$32.82	\$28.27	\$31.57	\$26.89	\$27.49
May 8-14	-8.45	4.59	0.28	6.95	4.47	-0.44	1.23
May 27-June 4	-23.23	-11.23	-4.81	-16.03	-13.44	-14.52	-13.87
June 14-23	22.80	-10.79	-18.64	-10.39	-16.64	-14.71	-8.06
June 28-July 13	-44.50	-42.21	-36.79	-35.52	-34.10	-25.67	-36.46

which is much greater than any other profit, and about \$30.00 better than that from the planting of May 8 to 14. The third planting shows a loss of \$8.83 an acre, due to the low yields of market grades produced by late May plantings. The better yields of the fourth planting, from June 14 to 23, show a calculated profit of \$17.46, which is significantly lower than that from the second and higher than the third and fifth plantings.

In the case of profits calculated for the Triumph, the data show that the profit from the first planting was greater than from any of the others. In fact, only \$1.23 profit could be calculated for the second planting, and significant losses were incurred from plantings made later than May 14.

Spacing Porto Rico, Triumph

Significant differences in the profits also were shown to result from planting at different hill spacings in the case of both varieties. These variations in profits due to spacing are about the same regardless of planting time, except that at the latest planting spacing had a lesser effect than at the others.

With Porto Rico at the first planting, the greatest profit is shown from the 24-inch spacing, the second from the 16-inch, and the third greatest profit is from the 8-inch spacing, but the differences between these are small and of doubtful value. At the second planting, the greatest profit also came from 16-inch spacing. It appears twice as profitable as the 42-inch. The 8-, 12-, 16-, and 32-inch spacings showed about equal profits at the second planting of Porto Rico. The third planting shows a loss at all spacings, except that a very small profit is shown for the 24- and 32-inch spacings. At the fourth planting the most profit is indicated from the 12-inch spacing, but is not significantly better than the 16-inch. These two spacings are much better than any other at that planting time. No spacing shows a profit for the July plant

ing time, and the losses calculated are great enough that a chance could hardly be taken on the planting of Porto Rico that late.

With the Triumph planted April 15 to 25, the highest profit is indicated at the 16-inch spacing, but the 12- and 32-inch gave profits practically identical with it, and profit for the 24-inch is not significantly lower. Only the 8-inch and the 42-inch spacings show profits significantly lower than the others. At the second planting the highest profit is indicated from 24-inch spacing, but the 12-inch seems about as good. The 8-inch shows a significant loss and the 42-inch a small loss. With the single doubtful profit for the 8-inch spacing at the fourth planting, no profitable planting can be expected with mule-equipment production of Triumph for starch after the second planting, thus limiting profitable plantings to the period not later than May 8 to 14.

SUMMARY OF MAN HOURS IN SWEETPOTATO PRODUCTION

War conditions have placed many restrictions on the farmer. Some of the factors limiting increased food production can be partly offset or adjusted by farm planning, by using the credit offered by public and private lending agencies, and by suitable cooperation between neighboring farmers. Such adjustments will reduce the critical importance of land, power, machinery, fertilizer, and planting materials. The limitation in farm labor may be further magnified with added war restrictions; hence a greater labor efficiency in crop production is desirable.

Fewer Hours With Wider Spacings

The many labor requirements for sweetpotato production and harvesting are shown in tables 7, 8, 9, and 10. The total man hours per acre, including the time for harvesting for the various yields of the Triumph production shown in table 4, are presented in table 13. The 8-inch

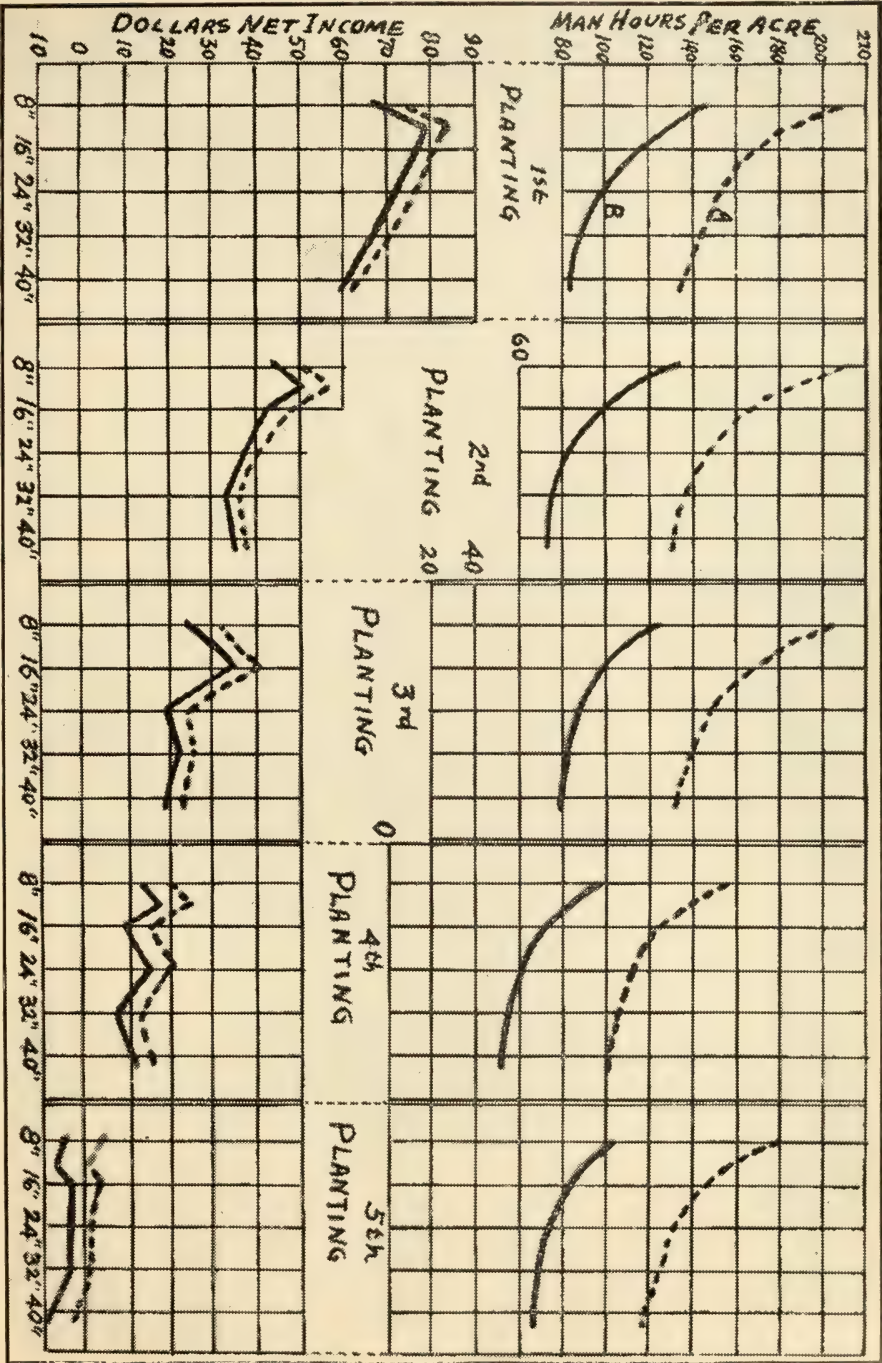


Figure 1. Man hour (upper section) and net labor income (lower section) from growing sweetpotatoes by different times of planting and hill spacings. A. using mule equipment and B. using tractor equipment.

plant spacing required 209, 213, 206, 158, and 182 man hours, respectively, for the five successive periods of planting using the mule method of production. The same amount of work was performed with the tractor method for the five successive plantings in 149, 134, 125, 98, and 106 man hours, respectively.

Using the tractor method and one-fourth the plants per acre in 32-inch spacing, the time requirements were 91, 77, 83, 55, and 70 man hours per acre, respectively, for the five successive plantings.

The saving in man labor from the 8-inch mule method by the use of improved equipment and methods would, by greater efficiency, produce and harvest in 5 plantings, 2.3, 2.7, 2.5, 2.9, and 2.6 acres of sweetpotatoes. The crop return on seed on increased acreage in the first and second plantings would represent an economical use of crop production factors.

Figure 1 shows the man hours of labor given in table 13, plotted above net labor

income per acre. This labor value was determined by the difference between the 1942 value of sweetpotatoes shown as the average yields, in table 4, and the total of all crop cost factors except labor.

The total labor incomes for the two methods give curves which are slightly different in values. This difference is caused largely by high machine costs in the tractor method. It is to be noted that the curves for labor income show a reduction in values for increased plant spacing and delay in transplanting. In the fifth planting period the curves drop below the line of profit. The curves for total labor required per acre show a reduction with wider plant spacing but relatively little reduction with the date of planting.

Labor Income Per Man-Hour

These several values for net labor income divided by total man hours as shown in figure 1 give the labor income per man hour, and are presented in table 14. Using mule methods this income varies from 49 cents to a loss of 2.7

Table 13. Total man hours required for growing an acre of sweetpotatoes, using mule and tractor equipment methods, and planting at various times and hill spacings; based on yields of 1940, 1941, and 1942.

Plant spacings	First planting		Second planting		Third planting		Fourth planting		Fifth planting	
	Mule	Tractor	Mule	Tractor	Mule	Tractor	Mule	Tractor	Mule	Tractor
8-inch	209.4	148.5	213.3	133.7	205.8	125.0	157.9	97.9	181.6	105.6
12-inch	184.3	126.7	185.6	112.2	181.8	107.7	138.6	82.3	157.9	90.7
16-inch	168.5	113.1	165.6	97.8	168.4	98.0	123.2	70.5	146.3	83.0
24-inch	152.9	99.2	146.9	84.1	147.7	87.9	114.4	61.4	132.3	74.6
32-inch	143.9	91.4	137.3	77.2	141.2	83.1	106.5	55.4	126.3	70.2
42-inch	135.2	85.0	131.3	72.7	133.4	79.5	102.2	52.0	117.2	65.8

Table 14. Value of man labor in cents per hour growing sweetpotatoes. Based on 3-year average yields, 1942 value of crop, less costs other than labor, divided by man hours required in connection with planting at various times and hill spacing.

Plant spacings	8-inch	12-inch	16-inch	24-inch	32-inch	42-inch
Mule equipment						
First planting	35.2	45.8	48.2	49.9	49.3	46.2
Second planting	23.6	30.6	28.5	28.7	26.9	29.3
Third planting	15.4	19.5	24.4	16.4	18.6	17.5
Fourth planting	13.3	17.7	12.8	17.0	12.3	15.8
Fifth planting	2.3	0.9	2.4	1.3	1.3	-2.7
Tractor equipment						
First planting	44.9	62.2	67.7	73.2	74.0	69.0
Second planting	32.4	45.5	43.1	44.1	43.1	48.4
Third planting	20.7	27.2	36.5	23.1	27.7	26.0
Fourth planting	12.9	21.5	13.7	24.4	15.5	23.1
Fifth planting	-4.2	-6.6	-3.4	-5.2	-4.6	-11.9

cents per hour. The value of man labor for the tractor method varies from 74 cents to a loss of 12 cents per hour. At the first planting, widening the hill spacing from 8 to 24 inches caused an increase in the value of labor of 14.7 cents per hour for the mule methods and an increase of 28.3 cents per hour for the tractor methods.

The total calculated hours required of the power units to produce sweetpotatoes with the mule and tractor methods show only minor variations. However, these differences shown are magnified in labor requirements, which have been discussed

Bushels Per Man-Hour

Production of sweetpotatoes per man hour gives another index of labor efficiency, as shown in table 15. Using the mule method in the first planting at 8-inch spacing, 1.8 bushels were returned per man hour of work and for the fifth planting, 0.67 bushels is the return. Using the tractor method 8-inch spacing, at first planting, 2.55 bushels are produced per man hour, and 1.16 for the fifth planting. The greatest return, 3.6 bushels per man hour, was on the first planting at 32-inch hill spacing with the tractor, and the lowest production was 0.67 bushels obtained on the fifth planting at 8-inch spacing with the mule method.

Labor and Profit Summary

Planting material is often the major limiting factor to large scale sweetpotato

production. Table 16 is a practical example for the use of yield data. This table is based upon the number of acres of sweetpotatoes that might be planted from the first four pullings which would be produced from 100 bushels of seed stock bedded in a flue heated hotbed. It is assumed the plants from two pullings in April would make an average yield equivalent to the reported first planting and that the pullings in the first half of May would have a yield equal to the second planting.

The average net profit per acre shown in tables 11 and 12 for the first two plantings multiplied by the calculated number of acres that can be planted at the various spacings gives a value for the total net income from 100 bushels of bedded seed. From this total net income must be subtracted the proportional part of the total annual plant bed cost that would be chargeable for the pullings that might be made, after the first four herein considered. This value is \$51.62 for the five plant beds. When this value is subtracted, the amount remaining is the calculated net sweetpotato income for the spacing or method of growing.

The total man hours required in April, May, and June to care for the beds, pull the plants, prepare the seedbeds, transplant and keep down weed growth is shown in table 16 for the calculated number of acres.

Table 15. Bushels of Triumph sweetpotatoes produced per man hour used in growing plants, production, and harvesting; based on 3-year average yields and calculated data from field costs in connection with planting at various times and hill spacings.

Plant spacings	8-inch	12-inch	16-inch	24-inch	32-inch	42-inch
Mule equipment						
First planting	1.81	2.14	2.23	2.29	2.29	2.20
Second planting	1.39	1.63	1.59	1.61	1.59	1.68
Third planting	1.13	1.26	1.43	1.22	1.29	1.27
Fourth planting	1.22	1.39	1.26	1.43	1.31	1.45
Fifth planting	0.67	0.67	0.75	0.76	0.75	0.68
Tractor equipment						
First planting	2.55	3.14	3.32	3.54	3.60	3.50
Second planting	2.22	2.69	2.68	2.81	2.82	3.03
Third planting	2.01	2.27	2.53	2.15	2.31	2.82
Fourth planting	1.97	2.33	2.22	2.65	2.51	2.81
Fifth planting	1.16	1.17	1.31	1.33	1.39	1.22

Table 16. A practical example of the use of data from times of planting and hill spacing; based on utilization of plants from the first four pullings produced by 100 bushels of carefully harvested seed stock, bedded in hotbed. Triumph variety grown for starch.

	8-inch spacing	12-inch spacing	16-inch spacing	24-inch spacing	32-inch spacing	42-inch spacing
Number of acres from 100 bushels bedded	5.05	7.43	10.10	14.86	20.20	26.04
Man hours of labor in April, May and June: Mule methods						
Seedbed preparation	51.5	75.8	103.0	151.6	206.0	265.6
Transplanting	242.4	314.4	318.1	375.9	444.8	486.0
Cultivating	49.5	81.8	98.0	163.6	196.0	257.1
Hoing	125.0	185.7	250.0	371.4	500.0	650.6
Care of beds	109.0	109.0	109.0	109.0	109.0	109.0
Total	577.4	766.7	878.1	1171.5	1455.8	1768.3
Man hours of labor in April, May and June: Tractor methods						
Seedbed preparation	23.6	33.2	47.1	66.4	94.3	116.3
Transplanting	107.6	123.0	131.5	135.6	149.5	156.0
Cultivating	19.2	28.2	38.4	56.4	76.8	98.9
Hoing	125.0	185.7	250.0	371.4	500.0	650.0
Care of beds	109.0	109.0	109.0	109.0	109.0	109.0
Total	384.4	479.1	576.0	738.8	929.6	1130.2
Average profit from 1st and 2nd planting dates, times acreage, less \$51.62*						
Mule method	\$37.20	\$81.64	\$115.54	\$210.06	\$312.38	\$292.76
Tractor method	36.40	193.64	275.97	447.67	571.04	712.52

*Calculated value of plant cost after four pullings if balance not used.

Using 8-inch hill spacing, 577 man hours would be required on 5.05 acres handled by mule equipment. Considering tractor equipment and planting at 16-inch spacing this same amount of labor or 576 man hours would handle 10.1 acres, which by the table give the grower a net profit of \$193.64 on the sweetpotato crop in contrast to a loss of \$37.20.

The data also show that, with mule methods, if the labor is approximately doubled by planting at 24- instead of 8-inch hill spacing (thus growing 14.86 acres instead of 5.05 acres) the profit would be increased by \$247.26. With a corresponding comparative use of a given quantity of plants in 8- and 24-inch hill spacing, the man hour requirement will increase from 384 man hours on 5.05 acres to 739 man hours on 14.86 acres with tractor methods. The profit on the crop is increased by \$411.27.

Harvesting labor requirements are not used in this comparison, because this operation can be conducted over a long period of time, required for efficient operation of a starch plant.

Effect of Planting and Spacing on Shape and on Content of Starch, Carotene

Because the shape of the roots of sweetpotatoes has a direct and important influence upon the market quality if used for human food, and a less important influence upon conveying and handling the crop in a factory if for industrial utilization, representative samples of roots were measured on the plots of these experiments and their shape recorded by a calculation of the ratio of their length to their diameter.

Samples were taken from representative plots of the Triumph variety grown in these experiments and laboratory determinations of starch and moisture contents were made to study the effects of time of planting and hill spacing upon the production of starch to the acre. In order to study the effects of these treatments upon carotene content of a yellow-colored variety, representative samples were taken from different spacings and times of planting of the Porto Rico and

laboratory determinations made of their moisture and carotene content. Carotene changes to vitamin A in the body, and this is an important food constituent.

The data in table 17 shows the effect of time of planting and spacing upon the starch content of the Triumph variety and the carotene content of the Porto Rico variety. There was some variation in the data for the three years, but the average figures show that the starch content of the 8-, 16-, and 32-inch spacings was practically the same.

More Starch in Early Plantings

Time of planting affected starch content significantly. There was, however, no difference between the first and third plantings. At the 8-inch spacing the fifth planting had approximately 3 percent less starch. This was true also at the 32-inch spacing, and 4 percent was lost by delayed planting at the 16-inch spacing. A 3 percent loss in starch for a 200-bushel yield means about 360 pounds of starch to the acre, lost by planting from June 28 to July 13 instead of 3 weeks earlier. These results indicate that plantings for starch should not be made later than the first part of June.

Variations in Carotene Content

In carotene content of the Porto Rico, the data for individual years and plots contained considerable variation. In each year differences due to spacing were significant, while the differences due to time of planting effects were large enough to be of significance only in 1941. The differences between the various years are not understood. In the average figures the table shows that the wider spacings

and the later plantings made potatoes that contained less carotene.

Observations at the time of harvest showed that the flesh color of the samples from the July plantings was very much lighter than that of the April or May plantings, the greater difference being between the April and July plantings. The skin color was not noticeably influenced by time of planting or hill spacing. The data show that the differences in color between the 8- and 16-inch spacings were not great, but between the 8- and 32-inch spacings they were great except at the third planting.

Planting Time Affects Shape

Table 18 presents data obtained from the average of measurements of the length and the thickness of representative samples of roots produced by a close, a medium, and a wide hill spacing and from an early, a mid-season, and a late time of planting. The figures in the table, which are called shape indexes, were calculated by dividing the average of the lengths of the roots measured by the average of the diameter of the same roots. Hence a small index indicates a short, chunky shaped sweetpotato, and a large index indicates a long, slender sweetpotato.

Food markets prefer a moderately slender-shaped sweetpotato; that is, one that is neither excessively long and slender nor one that is decidedly ball or "turnip" shaped. Sweetpotatoes grown for industrial utilization would handle more easily in a factory by mechanical conveyors, washers, and the like if they were chunky rather than slender in shape.

Table 17. Starch and carotene content of sweetpotatoes planted at various times and hill spacings, average of 1940, 1941, and 1942.

Planting times	Percent starch (Triumph)				Units carotene (Porto Rico)			
	8-inch spacing	16-inch spacing	32-inch spacing	Time average	8-inch spacing	16-inch spacing	32-inch spacing	Time average
April 15-25	25.18	24.59	24.91	24.89	38.35	32.25	28.46	33.02
May 27-June 4	25.15	25.03	24.61	24.93	30.58	29.29	28.80	29.56
June 28-July 13	22.61	21.81	21.18	21.86	29.83	24.16	24.30	26.09
Space average	24.31	23.81	23.45		32.93	28.54	27.20	



Figure 2. Porto Rico sweetpotatoes. Left from plots set out April 24, 1940; right from plots set out June 28, 1940. Both dug October 10, 1940.

These data show that spacing of hills had little or no effect upon the shape of either variety. The small variations and differences shown are of no significance.

Time of planting, on the other hand, had an important influence upon the average shape of both varieties, but the effect is more pronounced in the Porto

Rico. Early planting yields more chunky roots. The Triumph is generally more slender than the Porto Rico, and it is not as sensitive to factors affecting shape as is the latter. The difference in the shape of the Porto Rico grown from plantings made in April and in July is illustrated by figure 2.

Table 18. Effect of time of planting and hill spacing on shape of Porto Rico and Triumph sweetpotatoes, as shown by shape indexes*, average of 1940, 1941, and 1942.

Planting times	8-inch spacing	16-inch spacing	32-inch spacing	Time average
Porto Rico				
April 15-25	1.97	1.77	1.78	1.84
May 27-June 4	2.36	1.87	2.16	2.13
June 28-July 13	2.43	2.54	2.48	2.48
Space average	2.25	2.06	2.14	
Triumph				
April 15-25	2.57	2.59	2.56	2.57
May 27-June 4	2.33	2.60	2.83	2.59
June 28-July 13	3.48	3.04	3.37	3.29
Space average	2.79	2.74	2.92	

*Shape indexes obtained by dividing the average length of the roots by the average thickness of the roots.

Sugar Substitutes In the Diet



Sorgo sirup mill (foreground); evaporator under shed in background.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director

STATE COLLEGE

MISSISSIPPI

SUMMARY

1. Sugar rationing may be a blessing in disguise for the following reasons:

a. Before rationing, white sugar, a pure energy food, had been increasingly taking the place of other foods of greater nutritive value. Foods which supply protein, minerals and vitamins, as well as energy, will now be used in greater quantities.

b. Many sugar substitutes are superior in nutritive value to white sugar because they are not only good energy foods, but contain minerals as well.

2. More information is needed by the housewife in order to make a wise choice among sugar substitutes.

3. Most sugar substitutes are some form of sirup or molasses. Many of these are by-products in the manufacture of sugar, such as "refiner's sirup" and different grades of molasses. True sirups, such as sorghum, sugarcane, and maple sirups, have none of the sugar removed as is the case with "refiner's sirup" and molasses. Corn sirup is produced by breaking down cornstarch to sugars and purifying and concentrating the liquid.

4. Mineral analyses were made of many kinds of sirups and molasses, including commercial samples.

Great variation occurred in the iron, calcium, and phosphorus content of different products, as well as different samples of the same product. The minimum and maximum iron, calcium, and phosphorus content of 28 samples of sorghum sirup were: .0037 and .0336, .070 and .442, .0096 and .0660; of 35 samples of sugarcane sirup .0009 and .0115, .025 and .172, .0136 and .0660, respectively.

Sirups evaporated in iron pans averaged over twice as much iron as those evaporated in copper pans.

5. Most of the samples of sirups and molasses analyzed were good or excellent sources of iron and some were good sources of calcium. All of them were low in phosphorus. The lower grades of molasses had the highest mineral content. Sorghum sirup contained about three-fifths as much iron and one-third as much copper as these samples of molasses. Refiner's sirup and sugarcane sirup are good sources of iron. Corn sirup and honey have a low mineral content.

6. Sorghum sirup, sugarcane sirup, and blackstrap molasses are effective in curing nutritional anemia as determined by feeding tests on anemic rats. Their effectiveness depends upon their iron and copper content. When fed at the same iron level with sufficient copper, all are about equally effective.

7. Not all of the iron in foods is available to the body. The iron in sorghum, sugarcane sirups, and molasses was found to be 88 to 95 percent available. This was determined by feeding tests and chemical methods. The iron in sirups and molasses has a higher availability than that of a number of other foods of high iron content.

8. The use of sirups and molasses in place of sugar is to be recommended from a nutritional standpoint. Because of their high available iron content, their addition to the diet may be a practicable means of helping to prevent or cure the nutritional anemia which is common among women and young children.

Sugar Substitutes In the Diet

By OLIVE SHEETS, Department of Home Economics

In these days of food rationing it has been said that if "we know our groceries" we can be as well if not better fed "than when we thought more about what we wanted than what we needed." There can be no doubt that this statement applies to the use of sugar substitutes, and that sugar rationing may well prove to be a "blessing in disguise." Why is this true? In the first place, for some time the American people have eaten more sugar than was good for them and sugar consumption has been on the increase. In 1940 the per capita consumption of sugar in the United States, practically all of which was white sugar, was 115 pounds. This was a 7-pound increase over the preceding year. Such a high consumption of sugar results in an unbalanced diet because white sugar is a pure energy food. It takes the place of other foods which not only supply energy but also the necessary protein, minerals and vitamins in the diet. White sugar is completely lacking in these essential nutrients. A decreased use of sugar will bring about an increased use of other foods which contribute more to the diet than does sugar.

In the second place, many of the sugar substitutes are superior in nutritive value to sugar because they are not only good energy foods, but they supply minerals as well. Moreover, the sugar substitutes which have the highest mineral content are those which are available and cheap.

If the housewife is to make a wise selection among the many kinds of sweet foods which she may purchase in place of sugar, she needs to know more about how they are produced and which ones are the best buy from a nutritive standpoint.

Description of Sugar Substitutes

Practically all of the sugar substitutes are some form of sirup or molasses. These

products as sold on the retail market constitute a very heterogeneous class of sweet foods. Sirup, properly defined, is the product obtained by the evaporation of plant juice or sap, with no sugar removed, while molasses is the sweet liquid separated from sugar in the process of its manufacture. The terms, however, are used loosely and often interchangeably.

Products from the Manufacture of Sugar

Many so-called sirups and all molasses except beet molasses are produced in the manufacture of cane sugar. Since this is the case, a brief description of this very complicated process will be given. The cane is transported from the fields to the sugar factories where the juice is extracted, clarified, and evaporated in vacuum apparatus to a sirup. This sirup is then further evaporated in vacuum pans until saturated with sugar. The molasses, or uncrystallized portion, is separated from the sugar, and is then reboiled with additional sirup to obtain a second crop of crystals which are evaporated as before. This process of reboiling and separation of sugar is repeated until the molasses will not yield any more sugar by crystallization. In this way a series of molasses of decreasing purity and sugar content, called first molasses, second molasses, etc., is obtained. The final molasses is called blackstrap and is not used for human consumption.

The sugar coming from the sugar factories is a coarse brown product which has to be further purified. This is done in the sugar refineries. In the process of refining, different grades of so-called sirups or molasses are produced, but most of these are "reworked" for further extraction of sugar. The final product is called "barrel sirup" and is sold as blackstrap.

Much of the raw sugar is made in Cuba and sent to the United States for refining. In the large sugar factories only the raw sugar and the final molasses or blackstrap are marketed. In Louisiana sugar factories, however, where less mature cane is used, which yields molasses of better flavor, and in the smaller sugar factories, various grades of molasses are sold. The refineries also may market some of their better grades of sirup in addition to the final sirup.

Other products of the refineries are soft sugars including brown sugar. They are made from the lower grade sirups which would not yield white sugar and are classified according to color. They constitute less than 5 percent of the sugar output of American refineries.

Other Sirups

Sorghum, sugarcane, and maple sirups are true sirups, since they are made by boiling down the whole juice or sap until the desired consistency is reached and no sugar is removed. Most of the sorghum and all of the sugarcane sirup produced in the United States is made in the southern states, much of it on the farm on a small scale. During the fall of the year, the sorghum or sugarcane mill in operation is a familiar sight to the majority of persons who have lived in the South. Maple sirup, produced chiefly in the New England states, is made by evaporating the sap of the maple tree usually in open pans or kettles until it is of the desired consistency.

Corn sirup is manufactured and sold in increasingly large quantities in the United States. It is made by breaking down cornstarch with dilute acid into dextrins and sugars, neutralizing the resulting liquid containing these substances, clarifying and evaporating to a thick sirup. It is sold as corn sirup or in mixed sirups.

The majority of the commercial brands of sirups found on the retail market are

mixed sirups made from a variety of products. Most of them consist largely of corn sirup with one of the true sirups, or a refiner's sirup, or molasses added to give flavor and color. The consumer can determine the kind of sirup he is buying by looking at the label, since the Pure Food and Drug Law requires that the constituents used in the sirup be stated on the label.

Nutritive Value of Sugar Substitutes

The Home Economics Department of the Mississippi Experiment Station has made mineral analyses of many kinds of sirups and molasses. These have included numerous samples of commercial sirups and molasses in addition to samples of sorghum and sugarcane sirup made on farms located in all parts of Mississippi. A summary of the results of the iron, calcium, and phosphorus analyses of a number of sugar substitutes, including sorghum and sugarcane sirups, and typical commercial sirups and molasses, is given in table 1. Data on honey secured from reports made by other investigators as well as data on soft sugars have also been included, since honey is a common sugar substitute, and since soft sugars contain some minerals. The analyses on soft sugars were made by the Department of Home Economics.

The iron, calcium, and phosphorus content of some common foods which are rich in one or more of these minerals, is shown in table 2, in order that the sugar substitutes may be compared with them.

As might be expected, great variations occurred in the mineral content of different kinds of sirup and molasses, as well as in different samples of the same product. This was observed in the analysis of sorghum and sugar cane sirups. The maximum and minimum iron, calcium, and phosphorus content of 28 sam-

Table 1. The iron, calcium, and phosphorus content of sugar substitutes and soft sugars.

Product ¹	Sample	No. samples	Percent moisture	Percent moisture basis		
				Iron	Calcium	Phosphorus
Sorghum sirup	Av. of all samples	28	22.66	.0138	.152	.0275
Sugarcane sirup	Av. of all samples	35	23.64	.0039	.070	.0238
Maple sirup	Towle's Log Cabin	1	31.18	.0082	.021	.0059
Corn sirup	Karo Red Label	1	23.86	.0014	.009	.0061
Corn sirup and Refiner's sirup	Av. of 4 different brands	4	22.20	.0066	.055	.0068
Corn and sugarcane sirup	Av. of 5 different brands	5	24.73	.0032	.047	.0257
Molasses, Light New Orleans	Brer Rabbit Gold Label	1	23.10	.0051	.186	.0458
Molasses New Orleans	Brer Rabbit Green Label	1	24.11	.0190	.314	.0687
Molasses New Orleans	Aunt Dinah	1	24.45	.0199	.477	.0533
	Light Av.	14 ²		.0002	.005	.0035
Honey	Dark Av.	21 ²		.0005	.005	.0051
	Light yellow	2	1.73	.0006	.027	.0079
Soft sugar	Brown	3	2.86	.0027	.087	.0105

¹Analysis of all products except honey was made in the Departments of Home Economics and Chemistry of the Mississippi Experiment Station. See "The Mineral Content of Sirups, Molasses and Soft Sugars," O. Sheets, and R. W. Pearson, Technical Bulletin No. 22.

²Degree of pigmentation and its probable relationship to the mineral constituents of honey, H. A. Schuette, K. Remy, Jour. Amer. Chem. Soc. 54, 2909-2913 (1933).

The mineral constituents of honey. H. A. Schuette, J. D. Huenick, Food Research 2, 532 (1937).

Table 2. The iron, calcium, and phosphorus content of some common foods.

Food	Iron	Calcium	Phosphorus
	Percent	Percent	Percent
Beef, lean ¹	.0030	.013	.204
Egg yolk ¹	.0087	.157	.538
Milk ¹	.0002	.118	.093
Whole wheat bread ¹	.0030	.060	.370
Dried beans ¹	.0103	.148	.463
Turnip greens ²	.0030	.322	.065

¹Data from Sherman, H. C., Chemistry of Food and Nutrition, 6th Ed.

²Data from Dept. of Home Economics, Miss. Expt. Sta.

ples of sorghum and 35 samples of sugarcane sirup were as follows:

Sirup	Iron	Calcium	Phosphorus
Sorghum Max.	.0336	.442	.0660
Min.	.0037	.070	.0096
Sugarcane Max.	.0115	.172	.0660
Min.	.0009	.025	.0136

It was found that the iron content of the sirup was greatly affected by the type of pan in which it was evaporated. Sirups

evaporated in iron pans averaged over twice as much iron as those evaporated in copper pans. Contamination from dirt and dust also accounted for some of the iron in the sirup. Variations in the calcium and phosphorus content of the sirups, although marked, were not as great as those for iron. It is probable that differences in the composition of the cane due to differences in variety, soil, and climatic conditions, were chiefly re-



Figure 2. Evaporator commonly used in sirup manufacture. (Photograph above and on front cover by courtesy U. S. Department of Agriculture).

sponsible for variations in the calcium and phosphorus content in the sirups.

An examination of tables 1 and 2 shows that most of the sirups and molasses are good or excellent sources of iron and some of them of calcium, as compared with other foods. Sorghum sirup and two of the three samples of molasses contained more iron than any of the foods listed in table 2, although, with the exception of milk, these foods are regarded as being rich in iron. None of the foods had as high a calcium content as the two samples of molasses. It will be noted that milk, considered to be the best calcium food, contained less calcium than sorghum sirup and the three samples of molasses. It should be remembered, however, that fluid milk is about 85 percent water and that it, as

well as the other foods, would be consumed in larger quantities than would concentrated sweet foods, such as sirups or molasses. The sugar substitutes are rather low in phosphorus, but the amount present in most of the samples is not negligible. Of the products listed, it will be seen that the lower grades of molasses, as Brer Rabbit, Green Label, and Aunt Dinah have the highest mineral content. This is to be expected, since all the minerals present in the original cane juice and those which come from contact of the sirup with metal surfaces or other sources of contamination are concentrated in the molasses. Sorghum sirup, however, compares favorably in its average mineral content with the less refined molasses. Only two samples of molasses contained more iron than sorghum

sirup. Sugarcane sirup, although a good source of iron and a fair source of calcium, as compared with many other foods, had on an average less than one-third as much iron and one-half as much calcium as sorghum. The sample of maple sirup analyzed had a high iron content. It was made from maple sugar, however, which may have been contaminated with iron. Friedman and Holly found only .0012 percent iron in the maple sirup which they analyzed. In general, maple sirup has a low mineral or ash content.

Pure corn sirup is also low in minerals, but mixing it with refiner's sirup may raise the mineral content considerably. Many commercial brands of sirup are mixtures of corn sirup and refiner's sirup. The amount of minerals which they contain will depend upon the grade of refiner's sirup and the quantity added.

There is only a small amount of mineral matter in honey, but it is easily digested and provides a form of sugar which is quickly available to the body. The dark honeys have a higher mineral content than the light honeys.

Of the soft sugars only brown sugar can be relied upon to furnish appreciable amounts of minerals. Table 1 shows the average results for three samples, but one of these samples contained .0031 percent iron and .117 percent calcium.

Sirups and Molasses Cure Anemia

In addition to making mineral analyses of sirups and molasses, studies were also carried out to determine their value in curing nutritional anemia. This condition may be brought on by lack of iron and copper in the diet which are necessary for the building of the red coloring matter or hemoglobin of the blood. Thus, if infants are fed too long on a strictly milk diet they are apt to become anemic, since milk has a low iron and copper content. Except under these conditions, however, the diet is seldom lacking in copper, although lack of iron is a common dietary deficiency. If other foods

are eaten which supply enough iron, these foods will also supply ample amounts of copper. We are, therefore, concerned chiefly with the iron in the diet.

In conducting the studies on nutritional anemia, healthy white rats were kept on a milk diet from birth. Their condition could be observed by the appearance of the ears, paws and tail. When these lost their pink color the animals were anemic, since the hemoglobin or red coloring matter in their blood was reduced. The severity of the anemia was determined by testing the blood to find out how much hemoglobin remained in it. When an animal became sufficiently anemic, a weighed amount of the food to be tested containing a known amount of iron was added to his daily feeding of milk. A group of animals were fed in this way on each food, and their response to the food was determined by testing their blood at regular intervals for hemoglobin. By means of such experiments, it was learned that sorghum, sugarcane sirups and blackstrap molasses were effective in curing nutritional anemia. Blackstrap molasses was used because it was possible to obtain a plentiful supply of it for the feeding tests, and because of its high iron and copper content. The effectiveness of these products in curing the anemia was dependent upon their iron content when the animals received enough copper. All were about equally effective if fed at the same iron level with ample amounts of copper.

On an average, it required three times as much sorghum sirup and seven times as much sugarcane sirup as blackstrap to supply the same amount of iron. Table 3 shows the average gains in hemoglobin in 4 weeks of rats fed sorghum sirup, sugarcane sirup, and blackstrap molasses in amounts to supply the same quantity of iron.

Availability of iron in sirups and molasses: It has been found that not all of

the iron present in foods is available; that is, not all of it is in a form which can be utilized by the body. While the experiments on sirups and molasses demonstrated that the iron in the different samples tested was utilized about equally well, they did not show how much of the iron was available. This could be determined either by feeding tests on rats or by chemical analysis of the food. Both methods were employed when practicable, and one method was checked against the other. In the feeding tests two groups of rats received the same basal diet of milk plus sufficient copper, but in addition one group was fed the sirup or molasses to be tested in definite amounts. The other group received an iron solution containing the same amount of iron as that supplied by the sirup or molasses, but in a form which was known to be available. The increase in hemoglobin of the two groups of rats was compared.

The availability of the iron in sorghum and sugarcane sirups and molasses is shown in table 4. Composite samples of both sorghum and sugarcane sirups were used in the tests, because it was believed that they would be more representative than individual samples. It will be seen that most of the iron in sorghum and sugarcane sirups is available, judging by both the feeding and the chemical methods of testing. Blackstrap molasses was not tested by the feeding method to determine available iron, but the results of the other feeding tests indicated that it contained at least as much available iron as did the sirups, and, therefore, confirmed the results secured by the chemical method. Although no tests for available iron were made on the other sirups and molasses, it is probable that the greater proportion of the iron which they contain is available. McCance and Widdowson reported that 100 percent of the iron in black treacle, a low grade molasses, and 95 percent of the iron in Golden sirup, an English brand of sirup, were avail-

able. Harris and co-workers found by means of feeding tests that 90 percent of the iron in a first grade molasses and 80 percent of the iron in a second grade molasses were available.

Available iron in sirups and molasses compared with that of other foods: It is interesting to compare the available iron in other foods of high iron content with that of molasses and sirups. Such a comparison is made in table 5. The total iron, the percentage of iron which is available, and the available iron contained in 100 grams, or about $3\frac{1}{2}$ ounces, of each food is given. It was assumed that the samples of molasses would have about the same percentage of available iron as blackstrap molasses. If this is true, molasses would head the list, sorghum sirup would be second, and sugarcane sirup sixth, with regard to the amount of available iron supplied.

In the foregoing discussion, comparisons have been made of the calcium, phosphorus, iron and available iron content of sirups, molasses, and other food. In making use of sugar substitutes, however, it would be convenient for the housewife or dietitian to know approximately how much of each mineral is supplied by the quantity required in a given recipe. Eight ounces is equivalent to about three-fourths cup of molasses and the thicker sirups, and nearly a cup of the thin sirups. The amount of iron, calcium, and phosphorus furnished by 8 ounces of some of the most common sugar substitutes is given in table 6, and shown graphically in figure 1. Honey was not included because of its low mineral content. The products have been arranged in descending order with respect to their iron content, because this is the most important of the three minerals from the standpoint of the amount supplied.

The daily requirement for iron, as recommended by the Food and Nutrition Board of the National Research Council, varies between 6 and 15 milligrams,

Table 3. Gains in hemoglobin of rats fed sorghum, sugarcane sirup, and blackstrap molasses.

Food	No. rats	Iron	Copper	Av. gain in hemoglobin per 100 cc blood in 4 weeks
		received	received	
		milligrams	milligrams	grams
Sorghum sirup (composite sample)	11	.25	.0271	9.1
Sugarcane sirup (composite sample)	9	.25	.0777	9.9
Blackstrap molasses	12	.25	.0183	9.0

Table 4. The availability of iron in sorghum and sugarcane sirups and blackstrap molasses.

Food	Gains in hemoglobin in 4 weeks—gms. per 100 cc blood	Percent of iron available	
		Feeding method	Chemical method
Iron solution	10.5	100	100
Sorghum sirup (composite sample)	10.6	100	93
Sugarcane sirup (composite sample)	9.8	93	88
Blackstrap molasses	—	—	95

Table 5. Available iron in sirup and molasses as compared with that in some other foods with a high iron content¹

Food	Total iron in 100 grams*	Percent of iron available	Available iron in 100 grams
	milligrams	grams	milligrams
Molasses (Aunt Dinah)	19.9	95	18.9
Sorghum sirup	13.8	93	12.8
Sugarcane sirup	3.9	88	3.4
Liver	12.1	89	10.8
Soybeans, dried	12.1	90	10.9
Cowpeas, dried	5.8	95	5.5
Eggs	3.1	100	3.1
Whole wheat bread	3.0	79	2.4
Spinach	3.4	68	2.3
Turnip tops	3.0	65	2.0

*100 grams = about 3½ ounces.

¹Data taken from following sources: Sherman, H. C., Chemistry of Food and Nutrition, 6th Ed.; The Chemical Composition of Foods, McCance, R. A. and Widdowson, E. M.; Studies in Nutritional Anemia, Sheets, O. and Ward, M. V., Tech. Bul. 26, Miss. Expt. Sta.

Table 6. Minerals supplied by 8 ounces of some sugar substitutes.

Food	Fe	Ca	P
	milligrams	grams	grams
Molasses—Brer Rabbit Green Label	40.44	.711	.156
Sorghum	31.32	.346	.062
Karo—Blue Label	27.58	.127	.016
Corn sirup and refiner's sirup	14.95	.125	.015
Molasses, Brer Rabbit Gold Label	11.48	.422	.101
Cane sirup	9.01	.160	.054
Corn sirup and cane sirup	7.17	.107	.058
Karo—Red Label	3.09	.019	.014

the smallest amount being needed by children under 1 year of age and the largest amount by boys and girls over 12 years of age and by pregnant and nursing women. An inspection of table

6 and figure 1 shows that 8 ounces of molasses would furnish nearly three times the maximum daily requirement. The daily requirement for calcium varies as in the case of iron, with sex, age, and

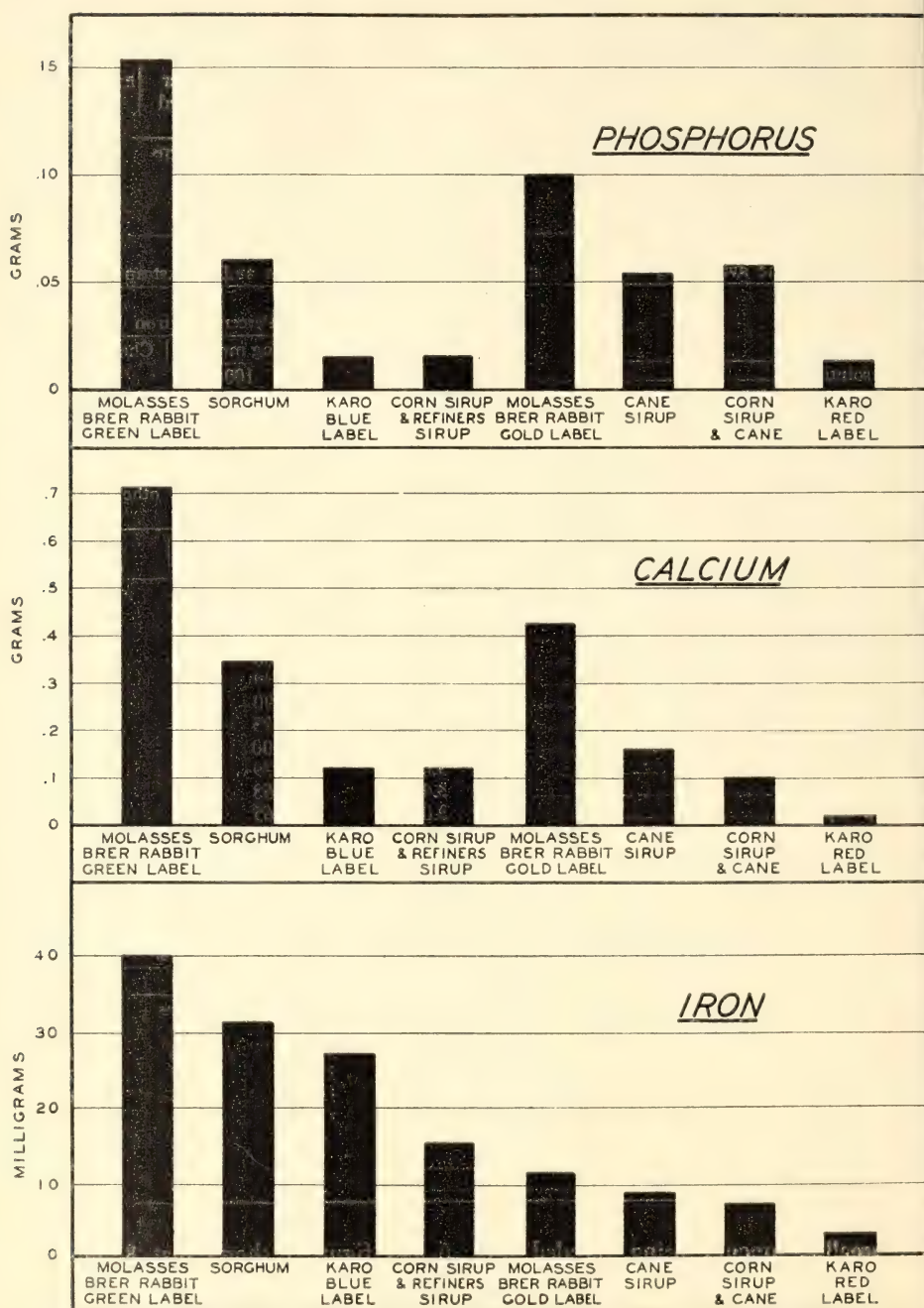


Figure 1. Iron, calcium, and phosphorus in 8 ounces of some sugar substitutes.

condition of the individual. It ranges from .8 gram for adults to 2.0 grams for nursing women.

Molasses contained the most calcium, and 8 ounces of one sample supplied .711 gram, or nearly the adult requirement. Sorghum sirup supplied about half of this amount. As already stated, molasses and sirups have a low phosphorus content. Eight ounces of the sample with the highest percentage of phosphorus would give .156 gram which is about one-tenth of the daily requirement for an adult.

It is evident from the data which have been presented that the use of sirups and molasses in place of sugar may raise the calcium and iron in the diet considerably. The less refined brands of molasses and sorghum sirup are to be particularly recommended, although a mixture of corn sirup and refiner's sirup, and sugarcane sirup may be very good sources of iron. Since it has been found that women and young children frequently suffer from nutritional anemia, the substitution of these products for sugar might well be a practicable method of improving their diets and helping to prevent or cure the

anemia. In this connection, attention may be called to an interesting report¹ of a study carried out on Hawaii sugar plantations. The plantation physicians had noticed a marked amount of anemia among the young children, in spite of the fact that they received vegetables after 3 months of age. A sugarcane juice concentrate, or sirup containing .00019 to .00024 percent iron was being used as the source of sugar in the formula for the babies. This concentrate was changed to another one having ten times as much iron. After the new concentrate had been used for two years, it was found that the average hemoglobin of the children under 3 years of age was 14 to 20 percent above the former average, and equally above that of children who had not received the new concentrate. It would seem that sorghum sirup, because of its higher iron content, might be even better than sugarcane sirup, as a source of sugar in formulas for infants.

¹A New Carbohydrate for Prevention of Nutritional Anemia in Infants. C. L. Wilbar, M. D. Amer. Jour. Diseases of Children 58, 45-60.



Effects of
Good Household Management
on Family Living

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EFFECTS OF GOOD HOUSEHOLD MANAGEMENT ON FAMILY LIVING

By DOROTHY DICKINS

Head of Home Economics Department

Data obtained in connection with a study of farm and industrially employed women made by the Home Economics Department of the Mississippi Experiment Station, showed that there is a relation between the activities of the wife and the level of living of the family, and that this relationship is more significant for the family of lower than of higher income.^{1/}

More information is needed about the contributions that can be made by the wife in a low income farm family. In what respects does the level of living of a farm family in which the wife is a good (or above average) home manager differ from the level of living of a farm family in which the wife is a fair or poor (average or below average) manager? How do the management characteristics of wives in these two groups differ? On the basis of such differences, what seems to be the best approach to improving managerial ability of wives of low income farm families? These are the questions with which this report will be concerned.

Methods and Scope of the Study

In planning this study the cooperation of the home management supervisors of Region VI (including the states of Mississippi, Arkansas, and Louisiana) of the Farm Security Administration was sought, as the families in the FSA program are low income farm families. The study was planned after consultation with a number of women employed in Region VI by the Farm Security Administration: the regional chief of Home Management; Miss Martha Dinwiddie; the Associate State Director of Mississippi, and several county home management supervisors, and after studying the Farm Family Record books kept by representative FSA families in 1941.

Choice of families. As originally planned, the study was to include 800 families: 400 white families, 200 of these with homemakers classified as "good" managers, 200 as "poor" managers; and 400 negro families, 200 of these with homemakers classified as "good" managers, 200 as "poor" managers. This would mean approximately four records each from about 200 counties or parishes^{2/} in the three states. Some counties would furnish data from white families only, others from negro families only, and others from both. All counties would furnish data from "good" and "poor" household manager families. The number of families to be selected in any particular county or parish would depend on the case load and would be decided by the Associate State Director. Records were obtained from four groups: (a) white families in which the wives more nearly met the description set up for good home managers; (b) negro families in which the wives more nearly met the descrip-

^{1/}"Some Contrasts in the Levels of Living of Women Engaged in Farm, Textile Mill, and Garment Plant Work." Dorothy Dickins, Miss. Exp. Sta. Bull. No. 364, Nov. 1941, pp. 26.

^{2/}The term "parish" is used in Louisiana to designate geographic and political subdivisions known as counties in most other states.

tion set up for good home managers; (c) white families in which the wives more nearly met the description set up for poor home managers; and (d) negro families in which the wives more nearly met the description set up for poor home managers.

The description set up for a good household manager^{3/} was as follows: (1) able to set goals and accomplish ends set; (2) has fund of information and uses it in solving problems; (3) conserves resources, recognizes signs of quality, uses money to advantage; (4) possesses skill in household tasks; (5) shares responsibilities with other members of family.

The description set up for a poor household manager^{3/} was as follows: (1) unable to formulate goals; (2) does not have a fund of knowledge or is not able to use what she has; (3) is wasteful of resources, does not recognize signs of quality, spends money unwisely; (4) lacks skill in household tasks; (5) is too ready to do what others in family should and might do.

County home management supervisors were instructed in selecting families from whom material would be sent, to consider all normal families (families with both husband and wife) on their program who had kept the farm family record book either completely or incompletely in 1941; in other words, to include in the group from whom the selection would be made families whose record books could be made satisfactory with additional questioning and checking. (It was thought that selecting families from the group with complete records only would not give the variation in household management desired.) Similarly county home management supervisors were further instructed to select families (in which the wives more nearly met the description of good home managers, and in which the wives more nearly met the description of poor home managers) as directed by the Associate State Director.

Data were secured from a total of 936 families, of which 576 were white families and 360 were negro families. More records were obtained from white families than planned, fewer from negro families. This was because many more records from white families were available, because (1) in 1941, 66,053 of the 87,961 families on the FSA program in the region were white families; and (2) members of white families have more schooling than members of negro families, and, therefore, more often furnish usable records. Some counties furnished more than their quota of records of white families.

The families from whom the data were obtained resided in 209 of the 221 counties or parishes in the region. In a few of the counties or parishes there are no FSA families; in some, very few FSA families. Therefore, records could not be furnished from families from every county or parish.

Wives in 328 of the 576 white families and in 192 of the 360 negro families were classified by their home management supervisors as good managers; those in 248 white families and 168 negro families, as poor managers.

Type of data. Material which was furnished by home management supervisors for every family selected included: (1) The 1941 Farm Family Record Book (kept by the family.) Data used in the record book were (a) the family record: members of household, sex, age, school grade completed, and organization participation; (b) the household inventory: kind of household property owned, number or amount, value; (c) the family operating expenses during

^{3/} This description is a modification of Nickell's and Dorsey's "Self-Evaluation of Home Management for Homemakers"—pp. 50-51, "Management in Family Living"—Paulena Nickell and Jean Muir Dorsey, John Wiley & Sons, New York, 1942.

1941. These were the data, it was found from a study of record books made at the time of planning the study, that were most often recorded by the families keeping farm family record books. (2) The Family Current Data Sheet (an FSA record secured by the home management supervisor by interviewing the family.) Information concerning housing conditions, newspaper and magazine subscription was taken from these sheets. (3) The Home Section of the Farm and Home Management Plan (an FSA record worked out by the family and the county supervisors). (4) The Supplementary Data Sheet (a schedule furnished by the Home Economics Department of the Mississippi Experiment Station, including information necessary for the study not to be found in the first three forms. These sheets were to be filled out by the home management supervisor after consultation with the family, the farm management supervisor, and after looking up certain records on file in the county office.) This form included questions concerning the amount of food and other farm products produced and consumed by the family in 1941, illnesses of the farm operator and wife in 1941, family cooperation, managerial ability of husband, value of house, and change in net worth of the family during 1941. (5) Classification of Wife Sheet. (This form was also furnished by the Home Economics Department of the Mississippi Experiment Station.) On this sheet the home supervisor was asked to classify the managerial ability of the wife: whether of her record keeping families this woman more nearly met the description set up for a good home manager or a poor home manager. The five characteristics of a good and of a poor home manager previously noted were listed. The supervisor was asked to check the two characteristics most responsible for the rating given.

Characteristics of Above Average Household Managers

The method of having county home management supervisors select families whose wives were among the best and among the poorest household managers of her record keeping families, gave records which isolated families in which the wives possessed varying managerial abilities; such records were desired for this study. Forty-eight percent of the wives in the 576 white families were rated by their home management supervisors as above average in household management of all wives in families under their supervision, 28 percent were rated as average, and 24 percent as below average. Forty-one percent of the wives in the 360 negro families were rated by their home management supervisors as above average in household management of all wives in families under their supervision, 31 percent were rated as average, and 28 percent as below average.

Due to the fact that household accounts are kept in homes of more good than poor household managers, there were more families with wives rating above average in household management with records to submit than families with wives rating below average in home management with records to submit. Therefore, there were more families with wives of average ability in household management classified as poor home managers than families with wives of average ability in household management classified as good home managers. Fifty-four percent of the white women and 52 percent of the negro women classified as poor managers were ranked as having housekeeping ability about average of all clients, while only 15 percent of the white homemakers and 23 percent of the negro homemakers classified as good were ranked as having housekeeping ability about average of all clients.

As may be noted from studying table 1, the management characteristics most often checked in classifying women whose ability was described by their home supervisors as above the average of women under their supervision, was ability in planning and directing and ability as a consumer buyer (characteristics 1, 3, and 5). Knowledge of household technique and skills is important, especially in homes where the homemaker is a worker-manager as were these women, but executive ability in managing a home, just as in managing a business, stands out. In most of the situations requiring good management there are minimum needs and limited resources. The good manager is able to supply these minimum needs economically. Presumably, if there are additional resources she will use them to the best advantage.

Table 1. Characteristics checked by supervisors in describing women rated above average in household management of all clients.

Characteristics	Percent with characteristic checked*	
	White women	Negro women
1. Able to set goals and accomplish ends set	67	66
2. Has fund of information and uses it in solving problems	17	12
3. Conserves resources; recognizes signs of quality; uses money to advantage	64	61
4. Possesses skill in household tasks	16	22
5. Shares responsibility with other members of family	36	39
Number of women	279	148

*Two characteristics checked for each woman.

The management characteristics most often checked in classifying women whose ability was rated by supervisors as below the average of clients under their supervision, were not clearly defined. This was no doubt because they were a more heterogenous group than the group rated as above average of clients under their supervision. Included in the below average managerial group were women who had had little or no housekeeping experience before marriage and were in the process of acquiring knowledge of housekeeping techniques and skills, of developing ability in organizing, directing and controlling the resources of their families. There were others who, though they had had years of experience, had failed to gain such information, skills or abilities. Poor health prevented others from attaining the rating.

Since there seems no clear-cut description for this group of below-average-in-managerial-ability, it has been decided to analyze the material obtained about them with the group which was classified as average in managerial ability. In other words, this report will concern families whose wives have been classified by home management supervisors as having household managerial ability above the average of their FSA clients, and the families whose wives have been classified as having household management ability about average or below average of their FSA clients. The first group, or families with wives of above average management ability, will be designated henceforth as families with AA manager-wives, the second group as families with AB manager-wives.

A question might be raised at this point by some as to the accuracy of the rating of the managerial ability of these women by their home management supervisors. All of the families included had been on the FSA program more than one year and all were known to their home supervisor. She had visited them in their homes and had been visited by them in her county of-

fice. She had had an opportunity to judge whether the women had ability to set goals and accomplish ends set, for she had helped the family with its farm-home plan and had supervised the wife in carrying out her part of the plan. In other words, the women were rated on managerial characteristics that could be actually observed (not intangible personality traits). It is possible, of course, that some of the home supervisors were influenced by the personalities of the women in making their rating, but the large number of cases in each group, it would seem, would take care of such bias, if it existed.

Managerial Ability of Husbands

At the time of planning the study it was realized that the level of living of a farm family is not only affected by the managerial ability of the wife but also by the managerial ability of her husband. A farm family in which the wife is a good household manager and the husband a fair or poor farm manager, might show a lower level of living than a farm family in which the wife is a fair or poor household manager and the husband a good farm manager.

Some simple method was needed for classifying husbands into good and average or below average managers. This difficult problem was presented to Dr. L. S. Allbaugh, Agricultural Economist at Iowa State College, who had formerly been associated with the Farm Security Administration. In his reply to our inquiry he listed six qualifications of good farm managers, based on 15 years of farm management records with a group of 1000 Iowa farmers. The two items which he considered probably the most important were: (1) ability in making decisions and getting things done; (2) family cooperation.^{4/} One of the questions asked on the Supplementary Data Blank was "Rate ability of husband in making decisions and getting things done (consult with farm management supervisor in making this rating): above average..... average..... below average..... (check correct reply)."

Table 2. Managerial ability of wives classified by ability of their husbands in making decisions and getting things done

Group	Number	Percent
1. White families	576	100.0
a. Managerial ability of wives above average	279	48.4
1. Ability of husbands above average	210	36.4
2. Ability of husbands average or below	69	12.0
b. Managerial ability of wives average or below	297	51.6
1. Ability of husbands above average	77	13.4
2. Ability of husbands average or below	220	38.2
2. Negro families	360	100.0
a. Managerial ability of wives above average	148	41.1
1. Ability of husbands above average	101	28.1
2. Ability of husbands average or below	47	13.0
b. Managerial ability of wives average or below	212	58.9
1. Ability of husbands above average	49	13.6
2. Ability of husbands average or below	163	45.3

^{4/} Other items listed by Dr. Allbaugh were: (1) ability to grow; viz., desire to learn and try out proven recommended practices; (2) ability to analyze situations and problems; (3) money management—as measured by relationship of recent purchases to needs; (4) skill in farm tasks.

It is interesting to note (table 2) that about the same proportion of husbands were classified as above average ability in making decisions and getting things done as of wives classified as above average ability in household management. About 50 percent of the husbands and wives of white families and 40 percent of the husbands and wives of negro families had been put in these superior categories.

The questions might well be asked: Were the above-average manager women the wives of above-average manager men? Were the average or below manager women the wives of average or below manager men? Table 2 tells us that in most cases they were. About three out of every four wives above average in household management had husbands above average in making decisions and getting things done. About three out of every four average or below in household management had husbands average or below in making decisions and getting things done. Likes may attract. On the other hand, having a wife with management ability above average may result in wiser planning by the husband and in such plans more often being carried out. Or having a wife with management ability average or below may result in less planning by her husband or in plans less often being carried out, or vice versa. The managerial ability of the wife cannot be considered apart from that of the husband. In some families the cup is running full of good management and in other families it is almost empty.

The Relation of Tenure Status and Home Management Ability

Sixty-five percent of the white families and 61 percent of the negro families in this study were owners or part owners. Forty percent of the white owner families and 44 percent of the negro owner families were tenant-purchase families. These families belong to a limited group of tenants, sharecroppers, and farm laborers who have been loaned money by the government to buy farms of their own. These tenant-purchase loans are made only in certain counties designated by the Administrator of the FSA on recommendation of the State FSA Advisory Committee. Ordinarily these are counties in which tenancy is most widespread or is growing most rapidly. The families

Table 3. Families with wives and husbands* of AA and AB managerial ability classified by tenure status

Tenure status	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Husbands AA managers	Husbands AB managers	Husbands AA managers	Husbands AB managers	Husbands AA managers	Husbands AB managers	Husbands AA managers	Husbands AB managers
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Owner ..	77.6	59.4	62.3	55.0	69.3	68.1	63.3	52.8
Renter ...	21.0	39.1	37.7	43.2	28.7	27.7	36.7	46.6
Sharecropper	1.4	1.5	0	1.8	2.0	4.3	0	.6
Number families	210	69	77	220	101	47	49	163

*The categories AA and AB managerial ability will be used in classifying husbands though they apply to only one management characteristic, ability in making decisions and getting things done. This may be justified by the fact that this characteristic is thought to be one of the most important in farm management. It was the most predominant characteristic of above average home managers, for "making decisions and getting things done" is just another way of saying "able to set goals and accomplish ends set."

designated to receive the loans have been selected from many applicants on the basis of character, ability, and farming experience by county committees. About 69 percent of the husbands in white tenant-purchase families, and 54 percent of the husbands in negro tenant-purchase families were rated above average of clients in making decisions and getting things done. About the same percentage of wives in these families received the rating of above average household managers.

Only 46 percent of the husbands in white owner (or part owner) families and 40 percent in negro owner families on the rehabilitation program were rated as above average in making decisions and getting things done. The proportion of wives receiving the above average rating in the two groups did not differ greatly from the proportion of husbands in the two groups who had received this rating.

The R. R. (or Rural Rehabilitation) program is for farm families (owners, tenants, croppers, and farm workers) who are having a hard time making a living and need financial aid and help in problems of farm and home. All renters and croppers and the majority of owners in this study were in the R. R. program. Data were obtained from no family in a homestead project. Families in these projects are not under the supervision of the associate state directors, whose supervisors cooperated by furnishing the data of the study.

As may be noted from studying table 3, having a wife of above average managerial ability was associated with ownership. Families in which the managerial ability of husbands was above average more often owned a farm when the managerial ability of the wives was also above average than when it was average or below. Families in which the ability of the husbands was average or below more often owned a farm when the ability of the wives was above average than when it was also average or below. Abilities in planning and carrying out plans, such as possessed by above average managers, are especially important in paying for a farm or in holding a farm once paid for.

Composition and Schooling of Family Members and Management Ability of Wives

White families with AA manager wives averaged 4.7 members; those with AB manager wives averaged 5.6 members. Negro families with AA manager wives averaged 6 members; those with AB manager wives averaged 6.3 members.⁵ In other words, there was a tendency, especially among white families, for wives with larger families to rate lower in household management. White families with wives of AB management more often had young children (table 4). Two-thirds had one or more children of 5 years or under. Forty percent of these had no daughter older than 5 years to assist in the care of the younger children. Wives in this group were somewhat younger than in the other three groups, averaging only 35 years of age (wives in the other three groups averaged 37 years of age).

Since AA manager wives in white families were older, it would be expected that they would have larger families as well as older children. That their families were smaller than families with AB manager wives may have been because they made more effort to limit the size of their families than did AB manager wives.

⁵/ The median size of the groups was about the same as the mean size.

In about one-half of the negro families of AB manager wives there were one or more children of 5 years and under; about four-tenths of the negro families with AA manager wives had children as young. Negro families more often had older daughters to assist in the care of their younger brothers and sisters than did white families. This may partly explain why the presence of young children does not seem to affect as adversely the management ability of wives in negro families as in white families.

Table 4. Proportion of families with children 5 years and under classified by management ability of wives

Children	White families		Negro families	
	Wives AA managers	Wives AB managers	Wives AA managers	Wives AB managers
	Percent	Percent	Percent	Percent
None 5 years and under	60.0	33.3	56.8	48.6
One child 5 years and under	23.3	29.6	13.5	19.3
Two 5 years and under	14.9	23.0	18.2	14.2
Three or more 5 years and under	1.8	14.1	11.5	17.9
Number families	279	297	148	212

Homemakers with young children and low incomes who live on farms can hire little or no assistance, nor can they buy any of the more expensive labor-saving equipment. Their houses are likely to be poorly planned. Much of their time must be given to cooking and cleaning. Little time is left for planning, directing, and buying. That as many women with young children ranked above average in household management as did in this study was no doubt in large part due to the assistance which they had had from the FSA. It had: (1) made available better planned houses and low cost labor-saving equipment; (2) given education in "best methods" of housework; (3) guided the women in farm-home planning. These are about the only methods of attacking the problem of management in such situations. One other possibility lies in increased participation of husbands and sons in household tasks.

Perhaps different standards for managerial ability need to be applied to women with young children, or better still, recognition taken of the fact that they are passing through a brief period in which AA management is difficult to achieve.

AA household managers had completed on an average one more grade in school than had AB household managers.⁶ The mean grade completed by white women of AA management ability was 8.6 grades; of AB management ability, 7.5 grades. The mean grade completed by negro women of AA management ability was 6.6 grades; of AB management ability, 5.5 grades. Husbands in all four groups had somewhat less schooling than had wives.

School children in both types of negro families were, as a rule, retarded in school for their age, but those in families in which their mothers' managerial ability was AB were more often retarded than those in families in which their mothers' managerial ability was AA. School children of white families were not, as a rule, retarded in school for their age. However, those who were retarded were more likely to be from families in which wives' managerial ability was AB. AB management women were more likely to keep their children at home

⁶ Median grade completed was about the same as the mean grade completed.

when there was an extra household task, or when there was illness in the family, than were AA management women.

Income and Home Management Ability

As very few of the farm-family record books examined at the time of planning the study contained fairly complete information on farm receipts and expenses during 1941, and since many of the farm-family record books contained fairly complete information on cash expenses for family living during this period, it was decided to arrive at income through the value of family living. Income may be defined thus as the sum of the value of family living and change in net worth. The value of family living was the sum of cash expenditures for family living during 1941 (obtained from the record book), plus the value of the occupancy of the home and the value of home-grown food and other products used by the family (derived from information furnished by home management supervisors on the Supplementary Data Blank).

The change in net worth was obtained by getting the difference in the net worth at the beginning and end of 1941 from the loan submission check sheet. If the net worth was greater on December 31, 1940, than on December 31, 1941, then the family had a decrease in net worth during 1941. If the net worth was greater on December 31, 1941, than on December 31, 1940, then the family had an increase in net worth during 1941. Some of the causes for increases during the year in net worth were increases in livestock, in crops stored, in investments in the farm and home; insurance premiums paid;^{1/} and payment of back bills and installments due. Some of the causes for decreases in net worth during the year were decreases in livestock, in crops stored, in investments of the farm and the home; rent, taxes, installments due, not paid.

As may be noted from table 5, the median income of white families with both husbands and wives AA managers was greatest, and the median income of negro families with both husbands and wives AB managers was least. When the managerial ability of the husband is held constant and that of the wife varied, income was greater when the managerial ability of the wife was AA or above average. Thus, in white families with husbands of AA management

Table 5. Families with wives and husbands of AA and AB managerial ability classified by median income, value of family living, and change in net worth, 1941

Item	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Income	1284	1046	1108	903	1109	923	876	766
Value family living	930	860	835	740	840	769	780	727
Change in net worth	+340	+200	+279	+160	+290	+167	+132	+75

^{1/} Since insurance is not included by the FSA in their net worth statements, the change in net worth was corrected to include premiums paid during the period. Economists in the FSA state the reason for not including insurance payments in the net worth statement is that most of the insurance is burial insurance. However, in this study burial insurance is regarded as life insurance as in the Consumer Purchases Study.

ability the median income was \$1284 when the wives' managerial ability was also above average, or AA, but only \$1108 when it was average or below, or AB. The special abilities of the AA women in planning and directing and as consumer buyers were no doubt the explanation for the greater incomes of families of these women.^{8/}

Families in seven of the eight groups most frequently had incomes of \$750-1499 (table 6). Families in the other group, negroes with wives and husbands of AB managerial ability, in most cases had incomes of less than \$750. There were relatively more white and negro families with husbands of AA management ability in the \$3000 and over family income class, but relatively fewer white and negro families with wives of AA ability in the \$749 or less income class. This supports the hypothesis that the contribution that can be made by an efficient home manager in the low income farm family is relatively great.

Table 6. Percentage distribution of income of families with wives and husbands of AA and AB managerial ability, 1941

Family income class	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
(Dollars)								
749 or less	13.3	17.4	18.2	34.5	19.8	31.9	36.7	47.9
750-1499	49.1	58.0	49.3	54.1	51.5	55.3	44.9	44.8
1500-2999	32.4	21.7	24.7	10.0	24.7	10.7	14.3	6.7
3000 and over	5.2	2.9	7.8	1.4	4.0	2.1	4.1	.6
Number families	210	69	77	220	101	47	49	163

The majority of families in all eight groups increased in net worth during the report year (table 5). Families in which the wives were AA managers, however, increased their net worth more than did families in which they were AB managers, the managerial ability of the husbands being the same. One would expect greater increases, however, in families of homemakers, a great percentage of whom had received their rating because of their ability (1) to set goals and accomplish ends set, and (2) to conserve resources, recognize signs of quality, and use money to advantage.

It is important to know not only that families in which the homemaker was an above average manager showed a greater increase in net worth, but it is important to know whether or not fewer of these families showed a decrease in net worth during the year. Eight percent of the families of AA white home managers with AA manager husbands and 6 percent with AB manager husbands showed a decrease in net worth during the report year. Eleven per-

^{8/} The FSA has estimated that net family income of their clients in Region VI averaged \$624 in 1941. Income is defined as net cash income received by the family plus the value of home used products. There are two reasons why the FSA average is lower than averages for this study: (1) The FSA includes in its definition of income neither increases in livestock and crops stored, nor value of housing, which are both included in the definition of this study; (2) The families of this study are not a representative sample of FSA families. They are, on the whole, superior families.

cent of the families of AB white home managers with AA husbands and 22 percent with AB husbands showed a decrease in net worth during this period.

Home supervisors classified very few white women as above average managers in families showing a decrease in net worth during the report year. Negro women in families showing a decrease in net worth were twice as often classified as above average managers. This may have been caused by misinterpretation of the question: "Of **all the farm women** under your supervision (non-record keepers as well as record keepers) how would you rate the ability in home management of the wife" by some home management supervisors. These may have actually answered this question instead: "Of **all the negro farm women** under your supervision (non-record keepers as well as record keepers) how would you rate the ability in home management of the wife," thereby classifying some of the negro women as above average when they really belonged in the average category. Seventeen percent of the negro families with both AA home and farm managers; and 19 percent with AA homemakers and AB farm managers showed a decrease in net worth. Twenty-one percent of the negro families with AB home managers and AA farm managers and 25 percent with AB home and farm managers showed a decrease in net worth. That there were more negro than white families with wives AB managers showing a decrease in net worth may be because the negro sample included more below average farm and home managers than did the white sample.

Value of Family Living and Home Management Ability

Since it costs more to feed or clothe certain members of the family than others, it is more precise to compare expenditures of groups of families differing in size and age composition on a unit rather than a per capita basis. To compute the number of food cost units to which a family was equivalent, the scale developed by food economists in the Bureau of Home Economics was used.^{9/} Clothing cost units were based on clothing expenditures of members of southern white and negro farm operator families included in the Consumer Purchases Study. The expenditures of the husband were taken as the unit, and figures for persons of other age and sex were expressed in terms of ratios to this value.^{10/} Values of all other classes of goods and services consumed by the families were figured on the per capita basis. Total value of family living per unit is the sum of the food, clothing, and "all other" values per unit.

AA management ability on the part of the wife seems to be a fairly good guarantee of above average value of family living of her family (table 7). Family living values per unit for families with AA manager wives were in all

^{9/} Persons 20 years or older 1.2 units; persons 13-19 years 1.1 units; persons 6-12 years .9 unit; persons under 6 years .6 unit. "Family Food Consumption and Dietary Levels," Misc. Pub. No. 405, p. 373, U.S.D.A.

	White	Negro
^{10/} Husband	100	100
Wife	97	94
Boys under 6 yrs.	24	28
Boys 6-12 yrs.	50	44
Sons 13 yrs. and over and other men under 30 yrs.	99	100
Other men 30 yrs. and over	89	94
Girls under 6 yrs.	24	28
Girls 6-12 yrs.	43	38
Daughters 13 yrs. and over and other women under 30 yrs.	109	75
Other women 30 yrs. and over	60	50

cases higher than values per unit for families with AB manager wives. In other words, families with AA manager wives have more and better food, better housing, and spend more on clothing and other consumer goods.

Cash expense for family living. An estimate was made at the beginning of the year in connection with farm-home planning of the cash that would be needed to purchase goods and services for the family. More cash was spent by the majority of families in all eight groups than had been estimated as needed, and more than had been budgeted. This was especially true in case of families of AA home managers. About three-fourths of the white families and three-fifths of the negro families of women in this category spent 5 percent or more than had been budgeted for family living, while about three-fifths of the white families and one-half of the negro families with wives of AB managerial ability exceeded their budgets as much as 5 percent.

Table 7. Families with wives and husbands of AA and AB managerial ability classified by median value of food, clothing, all other, and family living per unit, 1941

Item	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus-bands AA man-agers	Hus-bands AB man-agers	Hus-bands AA man-agers	Hus-bands AB man-agers	Hus-bands AA man-agers	Hus-bands AB man-agers	Hus-bands AA man-agers	Hus-bands AB man-agers
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Food per food cost unit	109	108	99	92	94	90	89	74
Clothing per clothing cost unit	18	16	14	13	17	16	13	12
All other per member	54	41	35	29	33	42	32	25
Family living per unit	186	170	148	137	150	142	140	114

The budgets as set up appear to have allowed little leeway for family variations and desires. When the family earned more than was planned, as was true of families in which the wives were AA managers, such desires could be satisfied. That families exceeded the amount budgeted does not mean, of course, that budgeting was of no value. A list of goods and services which must be bought no doubt served as an incentive to earn more in order to secure goods and services not so vitally important perhaps to the family, but very much desired.

The amount which will be available for farm family living is difficult to estimate, for income depends on many factors, some of which are outside the control of the individual family. In assisting a family in setting up a budget it is assumed that the factors will not be altogether favorable or unfavorable. When the family is one in which the abilities of both husband and wife are average or below, an overoptimistic estimate of the income and of the amount available for family living may have been made. When the estimated income is not earned, then the amount budgeted for family living must be reduced. This seems to explain why 15 percent of the white families with both husbands and wives of AA managerial ability and 31 percent with both husbands and wives of AB managerial ability spent 5 percent or more less than had been planned; why 17 percent of the negro families with both husbands and wives of AA managerial ability and 40 percent with husbands and wives of AB

managerial ability spent 5 percent or more less than had been planned. Briefly stated, these families did not have the money to spend.

Median cash expenditures for family living varied from \$266 for negro families in which both husbands and wives were AA managers, to \$190 for negro families in which husbands and wives were AB managers (table 8). In other words, cash spending was strictly limited in all groups, but especially in the AB manager families, which were also the lower income families.

Table 8. Families with wives and husbands of AA and AB managerial ability classified by median percentage of total cash expenses for family living for specified goods and services consumed, 1941.

Goods and services*	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Food	35.1	35.9	42.4	44.8	36.2	39.2	39.2	40.2
Clothing	24.5	22.5	23.1	22.5	29.7	24.6	26.4	26.4
Personal	4.7	4.4	4.9	4.2	3.5	3.7	3.0	3.4
Medical care	6.4	8.6	5.5	6.4	6.5	6.8	6.9	8.0
Household operation ..	7.9	6.6	6.6	5.3	5.6	5.8	4.5	3.9
Minor** housing	0	0	0	0	0	0	0	0
Minor** furniture and equipment	4.2	4.8	2.6	3.0	3.3	3.2	3.5	2.2
School, church, recrea- tion, transportation, and gifts	8.0	7.4	5.4	4.1	7.4	8.4	8.2	5.4
All other	.2	0	0	0	0	0	0	0
Median cash expenses for family living	\$264	\$234	\$254	\$209	\$266	\$217	\$201	\$190

*Classification used by the FSA in 1941 is used here. Tobacco is included under personal. Transportation expenses were combined with school, church, gifts, recreation, as this combination was made in a number of the record books submitted. Free text books are furnished in Mississippi and Louisiana.

**Major items of housing, furniture, and equipment were regarded as increase in net worth.

About two-thirds of the cash spent for family living by all groups, except white families in which the wives had AA home management ability, was spent for food and clothing. White families in which the wives had AA home management ability spent somewhat less than two-thirds. Because they spent somewhat less for food, there was relatively more for other goods and services.

Cash expenditures for food included food bought and consumed at home and away from home. A very small proportion of the food dollar, however, was for food away from home, most of this being for school lunches. The majority of children in all groups took lunches from home. The children in one-third of the white families with school children, however, bought some or all of their lunch at school or at the store. Less than 10 percent of the children in negro families with school children purchased lunches at the school or at the store. The economic status of negro families was lower than of white families. Then, too, negro schools were less often provided with lunch rooms than were white schools.

Children in homes of families in which the wives were classified as AA home managers were more often provided a school lunch, either in the form of food to be taken from home or cash to purchase, than were children in homes of families in which the wives were classified as AB managers. Twenty percent of the white families with school children and in which the wives were AB home managers, and 30 percent of the negro families with school children and in which the wives were AB home managers, carried no lunch to school or were provided no cash with which to purchase a lunch. The proportions for families with wives of AA managerial ability were 13 and 20, respectively.

Food. As has been shown in table 7, money value of food consumed per food expenditure unit per year was greater in families in which the wives rated AA in managerial ability than those families in which they rated AB. This was due to the fact that families with AA manager wives produced more food for family consumption, and not to the fact that they purchased more food. The median value of home produced food per food cost unit for white families in which both wives and husbands were AA managers was \$90; of families with AA manager wives and AB manager husbands, \$88; of families with AB manager wives and AA manager husbands, \$80; and of families in which both wives and husbands were AB managers, \$73. Median values for the four negro groups were \$80, \$72, \$74, and \$60.

Producing food for family consumption requires managerial ability: ability to plan, and to carry out such plans. It requires information about how foods should be produced, as well as skills in production. These families were fortunate in having home and farm supervisors to help them plan their food supply, to assist in making available necessary equipment and capital, and to give information concerning methods of production. Total values of food produced for family consumption exceeded by 10 percent the budgeted value of home produced food in 80 percent of the families in which the wives were AA managers (80 percent of the negro families as well as 80 percent of the white families). Sixty-five percent of the white families and 54 percent of the negro families in which the wives were AB managers exceeded their food-production budget by this amount.

Value of total production for home consumption is important, but producing and consuming food of various classes in amounts recommended by nutrition specialists is even more important. Table 9 shows the proportion of families in the eight groups producing and consuming milk, eggs, and canned vegetables in amounts recommended for "moderate cost diets."^{11/} These amounts are: 75 gallons or more of milk, 25 dozen or more of eggs, and 40 quarts or more of vegetables per person per year.

That milk consumption for the families of this study was much more adequate than egg consumption, was because each small family had been provided with at least one milk cow, large families with more than one milk cow. An adequate supply of milk had been especially stressed. This study preceded the poultry and egg producing campaign launched by the FSA in 1942 (table 9).

In spite of the fact that all families were assisted in producing food for home consumption, families in which the wives' ability was rated as AA pro-

^{11/} "Food Guide for the Mississippi Farm Family of Moderate Income," May Haddon, Miss. Ext. Cir. 108, May 1941. Based on Hazel Stiebeling's market lists of moderate cost meals.

Table 9. Proportion of families with wives and husbands of AA and AB managerial ability producing and consuming specified foods in quantities recommended by nutrition specialists

Foods	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus-bands	Hus-bands	Hus-bands	Hus-bands	Hus-bands	Hus-bands	Hus-bands	Hus-bands
	AA man-agers	AB man-agers	AA man-agers	AB man-agers	AA man-agers	AB man-agers	AA man-agers	AB man-agers
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Milk	88.1	88.4	84.4	72.3	70.3	80.9	67.3	62.3
Eggs	53.8	49.3	23.4	38.2	27.7	27.7	30.6	17.2
Canned vegetables	75.3	73.9	45.5	46.8	55.4	42.6	40.8	31.9

duced more adequate amounts. After all, it is up to the family to carry out plans, and families in which the wives rate high in ability to accomplish ends set, in sharing responsibilities with other members of the family produce more. The difference in amounts of vegetables canned in families in which the wives were AA and AB managers was greater than the difference in the amounts of milk and eggs produced. This may be because having a supply of home canned vegetables is even more dependent on the wife than is having a supply of home-produced milk and eggs.

Clothing. Included in the household inventory is a place for recording value of clothing owned by members of the family. Since this item was not filled out in many of the record books examined at the time of planning the study, it was decided not to ask for the information. However, when the record books came in, the vast majority (95-99 percent) of the families in every group had furnished this information. It was, therefore, decided to make use of it. The median value of wardrobes per clothing unit is given for all groups in table 10. In arriving at clothing values, "utility value" was used; (that is, value of further usefulness of clothing).

Wardrobes of families with AA home managers were of greater value than wardrobes of families with AB home managers (table 10). Families in which the wives' managerial ability rated above average were families having higher incomes, and hence more cash to spend for clothing; they were also families that utilized well the clothing they did have, as table 11 shows. A difference

Table 10. Families with wives and husbands of AA and AB managerial ability classified by median cost per clothing unit and median value of clothing inventory per clothing unit, 1941

Item	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus-bands	Hus-bands	Hus-bands	Hus-bands	Hus-bands	Hus-bands	Hus-bands	Hus-bands
	AA man-agers	AB man-agers	AA man-agers	AB man-agers	AA man-agers	AB man-agers	AA man-agers	AB man-agers
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Median value of clothing inventory per unit	24	17	18	15	21	17	17	15
Median cost per clothing unit	18	16	14	13	17	16	13	12

in cash expenditure, for instance, of \$4 per clothing unit per year would not altogether account for the big difference in the proportion of white families with AA manager husbands and with AA and AB manager wives who dressed above average for clients—a difference of more than 50 percent. The AA household manager not only possesses skill in clothing construction, but rates high as a consumer buyer.

Table 11. Proportion of families with wives and husbands of AA and AB managerial ability classified by rating given by home supervisors as to how well dressed.

How well dressed	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus-bands AA man-agers	Hus-bands AB man-agers	Hus-bands AA man-agers	Hus-bands AB man-agers	Hus-bands AA man-agers	Hus-bands AB man-agers	Hus-bands AA man-agers	Hus-bands AB man-agers
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Above average of clients	77.6	65.2	24.7	13.2	59.4	31.9	26.5	9.2
Average of clients	22.4	34.8	68.8	60.0	40.6	66.0	73.5	66.9
Below average of clients	0	0	6.5	26.8	0	2.1	0	23.9
Number families	210	69	77	220	101	47	49	163

That the appearance of their families does count has certainly been recognized by home economists of the FSA. They have been especially anxious that families under their supervision have sufficient clothing to participate socially with other farm families. Exhibits of attractive low cost wardrobes for different members of the family have been passed around from one group of clients to another.

In this connection it might be of interest to compare clothing costs of families of this study with clothing costs of socially participating white farm families in a study made in Mississippi during 1940-41.^{12/} A white family of this study with five members, i.e., for instance, a husband, a wife, a 15-year-old daughter, a 12-year-old daughter, and a 10-year-old son, would spend \$72 a year for clothing if the husband and wife were both AA managers, \$52 if both were AB managers. They would spend \$64 if the wife was an AA manager and the husband an AB manager, and \$56 if the wife was an AB manager and the husband an AA manager. The typical socially participating white farm family of this size and family composition in the Mississippi study spent \$90 for clothing. In other words, no group of FSA families spent as much as did the average group of families in the Mississippi study which consisted of families who had enough warm clothing, but who did not spend above the average amount for clothing.

From this it would seem that if greater social participation is desired for low income families, such as in this study, greater amounts of cash must be expended for clothing. The little difference in yearly cost per unit and value of inventory per unit (table 10) indicates that members of these families had

^{12/} "Clothing Supplies of Socially Participating White Farm Families of Mississippi," by Alice Bowie and Dorothy Dickins, Miss. Exp. Sta. Tech. Bull. 30, June 1942.

little heavy clothing that lasts over several years, such as is needed to keep warm.

Housing. On the Supplementary Data Sheet the supervisor was asked to "give the approximate value of the house in which the family lived in 1941 (check nearest figure) \$250 _____ \$500 _____ \$750 _____ \$1000 _____ \$1500 _____ \$2000 _____ \$2500 _____ \$3000 _____. If over \$3500, state approximate value _____." In only 2 of the 936 schedules was the figure \$3000 checked. In no case was a house reported as being worth more than \$3500. The majority in all groups, except those with AA manager wives and husbands, had houses valued at either \$250 or \$500 (table 12). These AA manager families had houses valued at either \$1500 or \$2000 most frequently.

Table 12. Proportion of families with wives and husbands of AA and AB managerial ability classified by approximate value of houses in which they resided in 1941

Value of house	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
\$250 or \$500	33.8	65.2	51.9	66.8	33.7	40.4	47.0	66.9
750 or 1000	20.5	17.8	16.9	8.7	25.7	23.4	18.3	12.9
1500 or 2000	43.3	17.8	30.0	23.6	39.6	36.2	32.7	19.0
2500 or 3000	2.4	0	1.2	.9	1.0	0	2.0	1.2
Number families	210	69	77	220	101	47	49	163

That the value of the houses of the AA manager families was greater was in the main not because their houses were larger, for median number of rooms per family was five for all groups, except those in which both wives' and husbands' managerial ability was AB (table 13). The median number of rooms per family in these two groups (white families and negro families) was four. The fact that AB managers had larger families as well as fewer rooms resulted in crowding. As may be noted from table 13, about two-thirds of the white families in which the wives were AB household managers and the majority in all four groups of negro families had less than one room per person. White families with wives of AA managerial ability were the only groups that averaged less than five persons per family. In other words, room crowding and size of family are related. Families do not ordinarily move into a larger house after the birth of a child. Older families remain in their too-large houses after the children are gone.

The principal reason why the houses of AA manager families were of greater value was that they were in a better state of repair (table 13). There is much that a family can do, without spending money, to enhance the value of their property. Above-average household managers direct family resources in such a way that such things are done.

There was not as great difference in percentage of families with houses screened and having sanitary toilets in the eight groups as in some of the other housing conditions. This was due to the fact that these two points (because they are related to health) have been especially stressed by the FSA. That

Table 13. Families with wives and husbands of AA and AB managerial ability classified by kind of housing

Item	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus-bands AA man-agers	Hus-bands AB man-agers	Hus-bands AA man-agers	Hus-bands AB man-agers	Hus-bands AA man-agers	Hus-bands AB man-agers	Hus-bands AA man-agers	Hus-bands AB man-agers
Median number rooms per family	5	5	5	4	5	5	5	4
Percent with less than 1 room per person	38	35	65	64	68	51	57	72
Percent with house in good repair	80	65	66	46	78	64	69	44
Percent with exterior of house painted	66	45	49	37	72	60	65	41
Percent with yard well kept	89	86	57	40	84	81	65	45
Percent owning lawn mower*	32	16	17	7	16	4	6	5
Percent with House screened	92	91	83	75	88	72	73	55
Percent with sanitary toilet	68	62	64	46	67	55	53	56

*Individually or cooperatively.

considerably fewer of the AB manager families had houses screened may have been because screens had not been taken good care of by this group, not that they had never been provided.

That so many of these families had sewing machines and pressure cookers (table 14) was no doubt because they had received loans from the FSA to purchase the same. Loans are made for such household equipment, for it is recognized by FSA administrators that a sewing machine and a pressure cooker are necessary equipment for producing clothing and food for the family. Families in which the homemaker had above average ability seemed, however, to have taken advantage of the opportunity to purchase such equipment somewhat more frequently than had families with less efficient household managers.

Such conveniences as a kitchen sink, a refrigerator, or an ice box, linoleum and measuring cups and spoons, were owned about twice as frequently in AA manager families as in AB manager families. The difference in the proportion of families having a kitchen sink was a somewhat more striking illustration of home management than for the other labor-saving equipment listed. AA home managers more often had a kitchen sink than an ice box or refrigerator, but AB home managers more often had a refrigerator or ice box than a sink. A kitchen sink is a time and energy saver; a refrigerator or an ice box a food saver.

Merely having an ice box is of little value, however, unless ice can be purchased regularly in warm weather. Some families lived outside of ice routes. Some did not live in rural electrification areas. Yet, a means of keeping food cool is a convenience needed, especially in an area where it is warm the greater part of the year as in Louisiana, Mississippi, and Arkansas. Improved facilities in rural communities as well as greater incomes are needed to

Table 14. Families with wives and husbands of AA and AB managerial ability classified by ownership of specified household conveniences

Household conveniences	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus-bands AA man-agers	Hus-bands AB man-agers	Hus-bands AA man-agers	Hus-bands AB man-agers	Hus-bands AA man-agers	Hus-bands AB man-agers	Hus-bands AA man-agers	Hus-bands AB man-agers
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Kitchen sink	60	43	35	25	54	40	29	19
Ice box	55	30	44	27	42	28	37	26
Sewing machine	87	84	81	77	82	77	61	63
Pressure cooker	93	97	84	87	96	85	88	81
Linoleum	71	48	43	35	48	57	33	23
Measuring cups and spoons	73	68	55	39	72	60	45	36

bring a big increase in the number of rural families owning and using refrigerators or ice boxes.

In table 15, the median value of household furniture and equipment including canning equipment and supplies is given. The value of furniture and equipment was the replacement cost less depreciation. Families with AA household managers had furniture and equipment of greater value. An above average household manager is much more likely to see to it that her domain, the home, has equipment that makes for more satisfying and comfortable living than is a fair or poor manager (tables 15, 16, 17). More families with AA household managers and AB farm managers had such equipment than families of AB household managers and AA farm managers, even though their incomes were less.

Table 15. Families with wives and husbands of AA and AB managerial ability classified by median value of household equipment and percentage of families owning specified household equipment

Item	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus-bands AA man-agers	Hus-bands AB man-agers	Hus-bands AA man-agers	Hus-bands AB man-agers	Hus-bands AA man-agers	Hus-bands AB man-agers	Hus-bands AA man-agers	Hus-bands AB man-agers
Median value household furniture and equipment	\$315	\$273	\$239	\$213	\$282	\$238	\$212	\$199
Percent with less than 1 chair per person....	7	10	21	33	23	15	35	43
Percent with 2 or more easy chairs	79	62	58	47	64	60	55	35
Percent owning a davenport or settee	49	43	35	25	45	26	22	21
Percent owning a dresser or chest of drawers	91	94	81	83	92	94	82	75

Families of AA home managers had more adequate bedding. Three or more members of the family were less likely to be crowded into one double bed (table 16). There were more likely to be two sheets on the bed, a pillow for each person, cover sufficient to keep out the winter cold.

AA manager families had better facilities for family gatherings and for receiving guests. There were more often davenports, easy chairs, and more chairs per person, in such homes; family members less often had to sit on the side of the bed or on boxes or on the floor; value of dishes, cutlery, glassware, and linen was greater.^{13/}

Medical care. About 58 percent of the families of this study belonged to health association groups. Families in which the wives were AA managers were somewhat less likely to be members, perhaps because they had somewhat

Table 16. Families with wives and husbands of AA and AB managerial ability classified by bedding facilities

Item	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers
Percent with less than .5 bed per person...	10	14	30	29	32	19	33	33
Percent owning 3 or more blankets	47	33	44	28	27	23	27	13
Percent with less than 3 sheets per bed...	56	67	68	76	69	66	76	79
Percent with less than 2 pillows per double bed	22	26	34	30	35	26	41	69
Median number quilts and blankets per bed	6.0	5.0	4.6	4.3	4.3	4.5	4.3	4.0

Table 17. Families with wives and husbands of AA and AB managerial ability classified by value of food preparation and serving utensils

Item	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Median value kitchen utensils	8	7	5	5	6	6	5	5
Median value linen, dishes, cutlery, glassware	12	10	8	7	9	10	6	6

^{13/} The FSA has recently made it easier for their ambitious homemakers to own adequate cooking and serving equipment by making such equipment available at low cost and allowing them time at low interest rate to make payments.

Table 18. Families with wives and husbands sick one week or more during 1941 classified by managerial ability of wives and husbands

Item	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers
Percent families with wife sick one week or more 1941	26	25	39	45	21	11	31	44
Percent families with husband sick one week or more 1941	11	14	14	21	7	4	4	18
Total number of families	210	69	77	220	101	47	49	163

less sickness. Under the FSA health association plan, each family agreed to pay a fixed sum (varying in the different counties) for specified services. In all cases the fee included physicians' services. In 50 percent of the cases it also included medicine. In about 30 percent of the cases it included hospitalization; and in 18 percent, dental care.

As may be noted from table 18, fewer AA manager wives had spells of illness of one week or more duration than did AB manager wives. This was true in negro as well as white families. No doubt some of the women rated as AB managers would attain the AA rating if they had better health. It takes pep and energy to do the household chores. Without this pep and energy the chores "wear one down, so one cannot give attention to planning and directing." The health of the wife affects the husband's managerial ability also. Having a healthy wife is especially important in families in which wives play as important roles in the occupation of their husbands as they do in these families.

Medical care programs such as have been initiated by the FSA in many of the counties make possible securing medical treatment at a cost that can be afforded. Families of this study belonging to health associations spent very little more for medical care than did the average family not in a health program. Such program will in the long run bring about better health and increased energy to do a good day's work.

Family Cooperation

As will be recalled one of the two factors considered perhaps most important for good farm management was family cooperation.^{14/} This factor is also important for good home management. The problem was how to determine the cooperation in a particular family. The following score card was worked out for that purpose:

^{14/}This discussion refers to economic cooperation.

Family Cooperation Score Card

		Score
I. Field work of wife	A. (1) Does not ordinarily work whole days or whole afternoons in field during crop season, or (2) ordinarily works whole afternoons in field but men and boys in family usually assist in heavy tasks, such as gardening, carrying water, canning	40
	B. Ordinarily works whole afternoons in field, men and boys do not usually help with heavy household tasks	20
	C. Ordinarily works whole days in field	0
II. Husband's interest in family food supply (as indicated by an affirmative answer to the following two questions)	A. There are 2 hours working time left in the week; the garden and the main cash crop both need cultivating. Under ordinary circumstances will husband cultivate the garden? (If answer yes, score is:)	15
	B. There are more hogs than will be required to provide the family a pork and lard supply. Under ordinary circumstances will the husband make adequate provision for the family before any hogs are sold? (If answer yes, score is:)	15
III. Decision as to purchased food and clothing	A. Decision as to what foods shall be purchased made by the family (not by an individual)	10
	B. Selection of clothing made by the family (not by an individual)	10
IV. Cash expenditures for alcoholic beverages and gambling by husband ^{1.5/}	A. No money spent on alcoholic beverages	5
	B. No money spent on gambling	5
Total score		100

As may be noted in "The Family Cooperation Score Card" much weight is given to the field work of the wife. It is thought that farm home managers who spend from sunup to sundown in the field must be in families where household management is lightly regarded, where "the farm's the thing." An

^{1.5/} In a few cases the supervisor could not furnish this information. If neither question in IV was answered, 15 each was allowed for two questions in III, and if only one was answered, 6 was allowed for it and 12 each for the two questions in III.

equally bad situation would be a farm home in which the husband spent whole days in household work. One rarely finds this situation, perhaps because men dislike doing household work more than women dislike doing farm work. In fact, many women prefer field work to housework. Especially is this the case with negro women (table 19). They like the crowd, the talking, and the singing of other cotton choppers and pickers.

Because many negro women do work out as farm laborers, because incomes of negro families are, as a rule, low, it is usually regarded as all right for the negro women to work all day in the field, though a bad situation for the white farm women. However, farm homemaking is a job, and time must be devoted to it by negro as well as white women, if they are to be successful managers (table 19). Little negro girls as well as little white girls need to be given interesting, challenging household tasks, such as making a cake, a dress, redecorating a room. They need praise for successful performance. The best time to develop skills and pride in workmanship is in early youth. Women, as well as men, like to do what they can do well. That the majority of wives in this study worked whole days in the field during crop season was in part because they had worked all day in the field ever since they were children. Many were more skilled in picking or chopping cotton than in making undergarments or making cornbread.

As may be noted from table 19, wives of white AA managers most frequently worked whole afternoons in the field during crop season. For low income families a part of the day in the field by the wife may be necessary, but when she gives this assistance it is most important that the men of the family help with heavy household tasks. AA home managers usually received this assistance. Thus, men and boys assisted in such tasks in 92 percent of the families in which both husbands and wives were AA managers, and in 54 percent of the families in which both wives and husbands were AB managers. They assisted in 72 percent of the families in which husbands were AA managers and wives AB managers, and 81 percent of the families in which husbands were AB managers and wives AA managers.

White, as well as negro, husbands were more likely to save out a meat supply for the family before making a sale than they were to work the garden

Table 19. Families with wives and husbands of AA and AB managerial ability classified by amount of field work wives ordinarily do during crop season

Amount of field work done by wife	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Wife works in field all day	32.9	37.7	51.9	62.3	64.3	68.1	75.5	81.6
Wife works in field whole afternoons	38.1	30.4	26.0	22.3	29.7	27.7	20.4	13.5
Wife works in field less than whole afternoons	29.0	31.9	22.1	15.4	6.0	4.2	4.1	4.9
Number of families ..	210	69	77	220	101	47	49	163

when the crops also needed working. This may have been because they, themselves liked meat more than they liked vegetables. However, husbands in 83 percent of the white families in which both husbands and wives were AA managers and in 64 percent in which husbands were AA managers and wives AB managers, would cultivate a garden if only two hours working time was left and both garden and main cash crop needed cultivation. The AA home manager no doubt knows better how to get the cooperation of her husband.

The decision as to purchased food and clothing was a family matter in the majority of families in all groups. But the husbands took over this function more often in families in which the wives' managerial ability was classed as AB. Thus in 3 percent of the white families in which both husbands and wives were AA managers and in 30 percent in which husbands were AA managers and wives were AB managers, the function of food selection was taken over by the husbands. In only 4 percent of the negro families in which both husbands and wives were AA managers and 22 percent in which husbands were AA managers and wives AB managers was clothing selected by the husbands.

In table 20 the eight groups of families are classified according to the score received when scored by the "Family Cooperation Score Card." Families with AA manager wives more frequently scored high in cooperation (80 and over), less frequently scored low (49 or less). Were they AA managers because they cooperated, or did they cooperate because they were AA managers? Many of the AA home managers were checked as being especially strong in "sharing responsibility with other members of the family." Perhaps they were AA managers because they cooperated.

There were fewer negro than white families in all groups scoring 80 and over in family cooperation, more in all groups scoring 49 or less. That negro families scored lower than did white families was in large part because more of the wives in negro families ordinarily worked from sunup to sundown in the field. (Due in part to lower economic status, in part to training and custom.) Another important explanation for their lower cooperation scores was the frequency with which negro men purchased the food without consulting their wives. This may have been a carry-over from the furnish system under which most of them had formerly worked. One took what was supplied and so there was no occasion to talk over with one's wife foods to be purchased.

Table 20. Families with wives and husbands of AA and AB managerial ability classified by family cooperation score

Family cooperation score	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
49 or less	6.2	13.0	27.3	51.8	14.8	27.7	30.6	68.1
50-79	29.5	31.9	33.7	26.8	52.5	42.5	53.1	23.3
80 and over	64.3	55.1	39.0	21.4	32.7	29.8	16.3	8.6
Total number of families	210	69	77	220	101	47	49	163

Sources of Home Management Information

All the families in this study were under the direct supervision of the FSA and the wives in these families were thus given much information concerning household management, individually and in discussion group meetings. So extensive is this field of household management, however, that the better managers sought information from additional sources. They and their children joined educational clubs (table 21).^{16/}

AA manager wives participated about twice as often as did AB manager wives in educational clubs other than FSA, such as agricultural extension clubs, adult education classes, vocational agriculture, or home economic clubs. In families in which both husbands and wives were AB managers, there was little participation on the part of these in such organizations. Poorer managers do not see the benefit of belonging to the extent that better managers do.

Table 21. Families with wives and husbands of AA and AB managerial ability classified according to participation of husbands, wives, and children* with educational clubs other than those sponsored by the Farm Security Administration

Participants	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers
Husbands	Percent 22.9	Percent 21.7	Percent 20.7	Percent 14.1	Percent 23.8	Percent 21.3	Percent 18.4	Percent 16.0
Wives	43.3	36.2	24.7	21.4	36.6	34.0	18.4	16.0
Children	43.7	48.0	33.3	36.6	28.6	24.2	16.7	17.1

*School and out-of-school children only. Percent of families with such children that participate in educational clubs other than those sponsored by FSA.

Better managers not only participated more in educational clubs and organizations, but more often subscribed to papers and magazines, especially home magazines (table 22). They more often had a good reading lamp to read by after the children were in bed. It would seem that the AB manager families were especially disadvantaged so far as sources of information were concerned, but these types of families receive more supervision from the FSA than do their better management families.^{17/} It is not in the main a problem of lack of information. Most people "know more than they do."

^{16/} It is possible, of course, to participate so much in clubs or organizations that one neglects management and every club has a few of this kind, but, as a rule, it is the better manager who is seeking more information. In fact, it is she or he who is getting the attention sometimes that should go to poorer managers. They get it because they seek it.

^{17/} The FSA classifies its families according to the supervision needed. Superior management families receive very little supervision. Inefficient managers receive a great deal of supervision.

Table 22. Families with wives and husbands of AA and AB managerial ability classified according to type of reading material subscribed to, ownership of a good reading lamp and radio

Item	White families				Negro families			
	Wives AA managers		Wives AB managers		Wives AA managers		Wives AB managers	
	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers	Hus- bands AA man- agers	Hus- bands AB man- agers
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Subscribe to:								
Daily paper	38	25	32	20	20	23	14	9
Weekly paper	56	51	60	42	50	23	37	31
Farm magazine	88	77	75	69	77	66	65	50
Home magazine	51	46	30	25	34	21	14	12
Other magazine	19	14	8	9	13	6	8	8
Own good reading lamp	61	45	43	22	45	34	22	13
Own radio	74	68	73	62	63	57	45	37
Total number of families	210	69	77	220	101	47	49	163

SUMMARY AND CONCLUSIONS

At the beginning of this report three questions were asked: (1) How does the level of living of a farm family with wife rating above average in managerial ability compare with that of a family in which the wife rates average or below in household management ability? (2) In what respects do these two types of household managers differ? (3) On the basis of these differences what seems to be the best approach to improving managerial ability of wives of low income farm families?

In order to answer these three questions, data have been secured from 936 FSA families in Arkansas, Louisiana and Mississippi; 576 white families, 48 percent in which the wives' managerial ability is rated above average of clients, 52 percent as average or below average; and 360 negro families, 41 percent in which the wives' managerial ability is rated above average of clients, 59 percent as average or below average.

The findings of this study, therefore, refer to low income farm families in which the contribution that can be made by efficient home managers is relatively great. The results may not apply to high income farm families. However, incomes of the majority of farm families in the South are low. It has been estimated that in 1935-36 the income of two-thirds of the southern farm families was less than \$1250.^{18/} Prices received by farmers for their products were somewhat higher in 1941 than in 1935-36, but the ratio of prices received to prices paid, interest, and taxes was about the same for the two periods.

Levels of living of farm families with wives of AA and AB managerial ability. The level of living of a family consists in the kind and the quantity of goods and services possessed at a given time or consumed during a given

^{18/} "Consumer Incomes in the United States," National Resources Committee. United States Government Printing Office, Washington, August 1938, p. 100.

period. It includes possessions of all sorts, such as household conveniences, land and buildings, income, health, and education.

Families with wives of AA (or above average) managerial ability, managerial ability of husbands held constant, had more and better food, better housing, and spent greater amounts on clothing and other consumer goods than did families with wives of AB (average or below average) managerial ability. They had more because they produced more farm products for home consumption and sale. They also utilized to better advantage the goods and services they had as is indicated by the fact that with a few dollars more for clothing, a large proportion of the families appeared better dressed than the average family in their group.

Families with AA manager wives had greater increases in net worth during 1941 than families with AB manager wives. More had been invested in land, buildings (including farm homes), furniture, and household equipment by families of the AA manager group. They were more often landowners. Their homes were of greater value, mainly because they were in a better state of repair, not because they were larger.

Fewer of the AA manager wives had spells of illness of one week or more duration during 1941 than did AB manager wives. Husbands in families with AA home managers also had spells of illness of this duration during 1941 somewhat less often than did husbands in the other group.

AA manager wives and their families participated in educational clubs other than those sponsored by the FSA, such as agricultural extension clubs, adult education classes, vocational agricultural or home economics clubs more often than did AB manager wives and their families. They more often subscribed to daily papers and magazines, more frequently had a good reading lamp.

There was only one year's difference in the schooling of AA and AB home managers, but children of AA managers were much less likely to be retarded in school. They were kept out of school less often for farm and home chores.

Differences in AA and AB household managers. AA managers were rated especially high in abilities: (1) in planning; that is, in using resources so that family goals might be realized, in adjusting these plans to changing conditions; (2) in providing a means for individual development; and (3) in using money to advantage for their families.

AB managers are not so easily described. In the group are a number of potential AA home managers; for example, some of the women overburdened with household chores because of one or more young children, or too ill to apply their energies where they will count most. There are those who are poor planners and directors, as well as those who do not have a knowledge of household techniques and skills.

Differences in management abilities of wives are accentuated, for AA home management women are more likely to be married to AA farm management men, AB home management women to AB farm management men.

Improving household management. As has been indicated, reasons for poor home managership may be many and may differ from family to family. There is no one remedy. One thing stands out: AA home managers usually rate high in ability in planning and directing family resources and in making

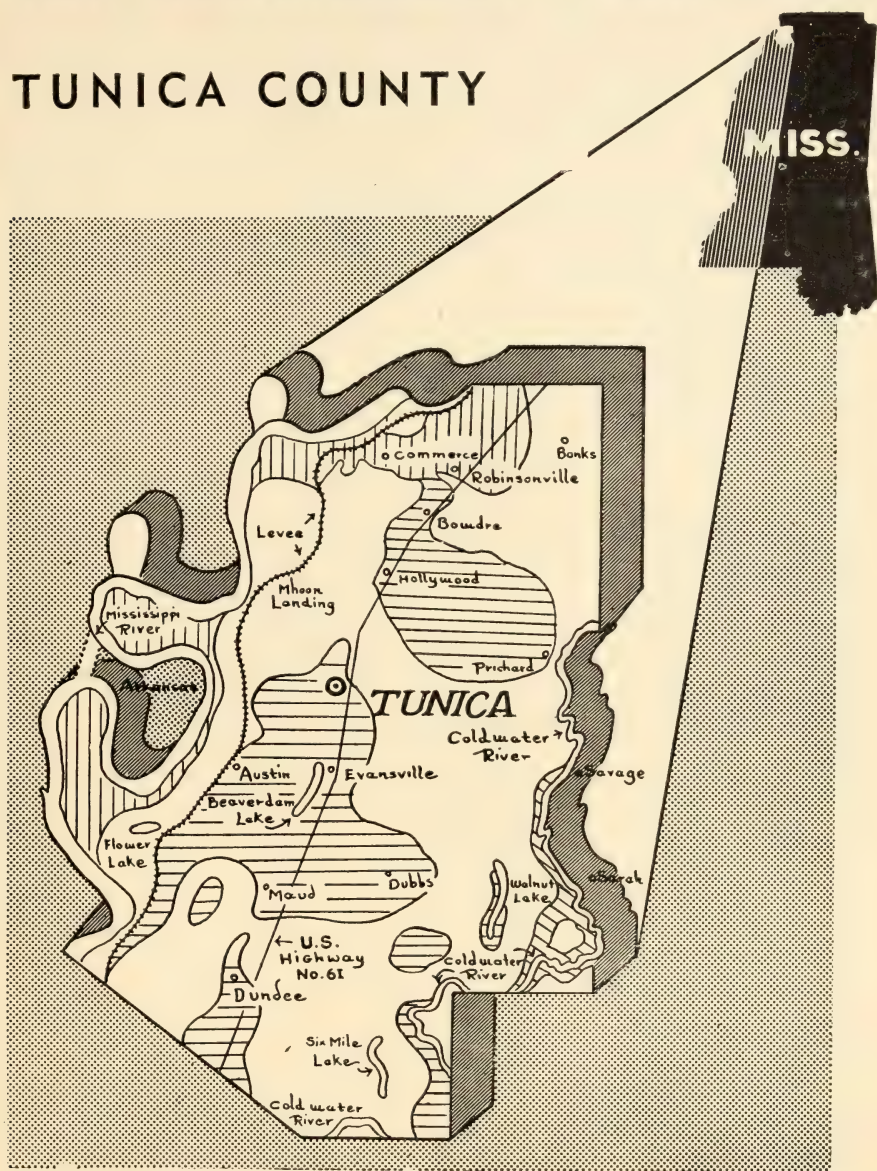
selections of goods on the market. It would, therefore, follow that these are the abilities with which the poor managers need special help and guidance.

Any steps taken to improve farm management will, it would seem, also improve home management, for the farm and home are closely associated. In low income groups the wife is a farmer as well as a homemaker. Better farm management makes possible better home management.

There is much that the woman can do to improve her own management, much that her husband can do. There is also much that society can do. In the case of these women, assistance had been received in the form of credit to purchase household equipment as well as guidance in household management. Many had had an opportunity of being a member of a health group. All these are important in improving household management.

SOIL MANAGEMENT PRACTICES

TUNICA COUNTY



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(For soil types, see Index on page 27.)

SOIL MANAGEMENT PRACTICES

Recommended for

TUNICA COUNTY

By L. A. DAVIDSON¹

All soils are developed by nature with certain properties so that some are adapted for the production of certain crops, while others are adapted for the growth of other crops, just as some cattle are suitable for the production of meat and others for the production of milk.

The many differences in fertility, texture, elevation, slope, and drainage of soils make it advisable to vary the management² for distinctly different soil types. It is the purpose of the soil survey to provide information that will aid the farmer in making the best practical use of each soil type on his farm.

This bulletin is intended for use with the accompanying soil map of the operator's farm. The report contains directions for using the soil map, a discussion of general principles of soil management, and a discussion of specific management for each soil type. The map shows the location of soil boundaries, the type and slope of soil in each area, roads, houses, ditches, and section lines. The discussion of management covers general soil management problems and describes the best adapted crops, rotations, fertilizers, and other practices for each soil type.

Definition of Terms

Some general definitions and explanations are given to aid and assist the farmers in getting the full benefits of the report.

1. **Alluvium** - material deposited by streams.
2. **Colluvium** - material deposited by gravity; colluvium is found at the foot of steep hills or embankments.
3. **Complex** - an area where it is impractical to separate the individual soils because two or more soils are mixed in a complicated pattern or the area is densely wooded.
4. **Depression** - low places where water is slow to drain off or does not drain off.

¹Soil survey made by Thomas Fowlkes (in charge), L. A. Davidson, J. A. Herren, and C. G. Morgan, Mississippi Agricultural Experiment Station co-operating with United States Department of Agriculture, Bureau of Plant Industry and Soil Conservation Service.

²Management includes all practices relating to soil use (fertilizers, adapted crops, rotations, drainage, and row direction).

5. **Escarpment** - a steep bank or "jump off."
6. **Management** - includes all practices relating to soil use (fertilizers, adapted crops, rotations, drainage, and row direction).
7. **Fallow** - a tillage practice where no crop is grown and the area is plowed frequently to kill weeds.

Explanations

1. The soils are designated on the map by three numbers; the first refers to the position of the soil; the second to the drainage; and the third to the texture of the surface (sand, silt or clay). For example, soil 125 is a first bottom soil, rather poorly drained, and has a silt loam surface.
2. There are nine groups of soils according to position and material from which they were developed. They are shown on the map as groups 100 to 900.

Soils Derived from Mississippi River Alluvium

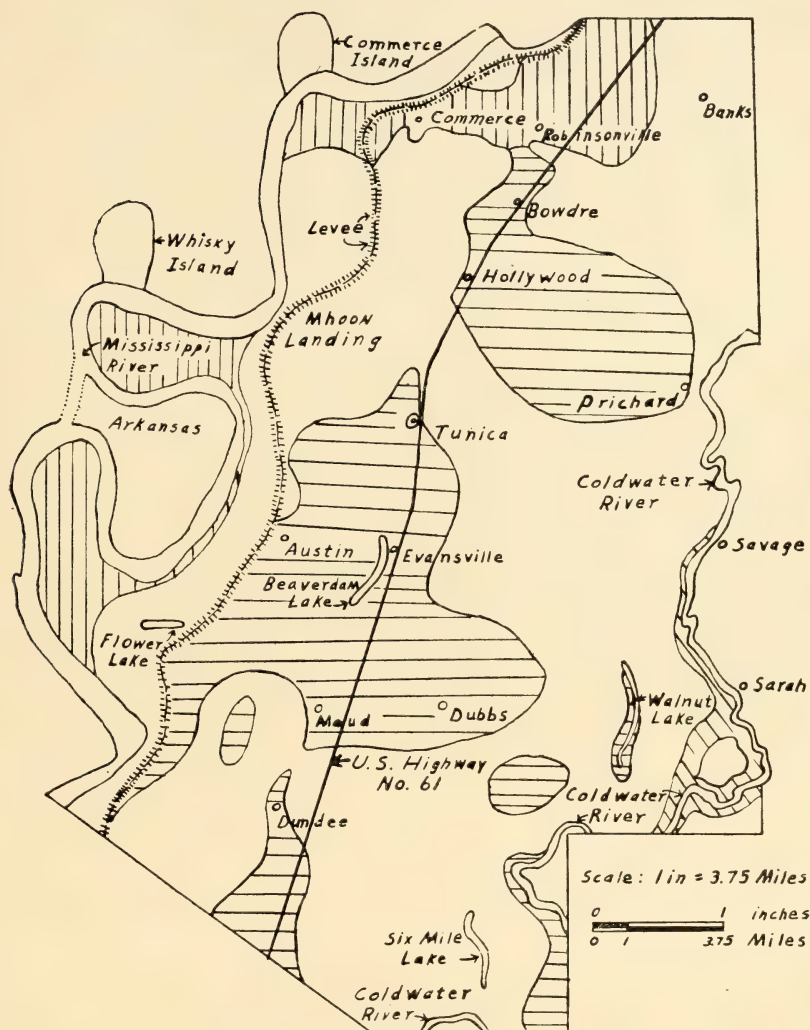
- a. **Group 100**, first bottom soils. These soils are found near the Mississippi River on both sides of the levee and consist of recent alluvium. These soils usually occur on the highest elevations in the "delta" and are known locally as "sandy" soils.
- b. **Group 200**, depressional soils. These soils are found in low wet places.
- c. **Group 300**, low bottom soils. These soils occur in the backwater areas of the Mississippi River flood plain. They are known locally as "buckshot" soils.
- d. **Group 400**, low terrace soils. These soils usually occur on elevations slightly higher than the first bottom soils (group 100) and are more acid. Most low terrace soils are known locally as "sandy" soils and the remainder are known as "light buckshot."

Soils Derived from Coldwater River Alluvium or Mixed Mississippi and Coldwater River Alluvium

- e. **Group 500**, first bottom soils. These soils occur near the Coldwater River and consist of recently deposited alluvium of this stream. Most areas are overflowed frequently and are known locally as "made land."
- f. **Group 600**, depressional soils. These soils are derived from mixed Coldwater and Mississippi River alluvium and occur in low wet places similar to group 200 soils.

Generalized Soil Groupings

Tunica County, Mississippi



First Bottom

Low Terrace

Low Bottom

Mississippi R.
Alluvium

Mississippi R.
And
Coldwater R.
Alluvium

First Bottom

Low Terrace

Depressions are not shown

Coldwater R.
Alluvium

- g. **Group 700**, low bottom soils. These soils are derived from mixed Coldwater and Mississippi River alluvium and occur in the eastern part of the county. They are similar to soils in group 300 in most respects except that they overflow frequently.
- h. **Group 800**, low terrace soils. These soils are derived from Coldwater River alluvium and occur near the present channel of the river.

Soil Derived from Colluvium of the Loess-capped Bluff

- i. **Group 900**, colluvial soil. This soil consists of mixed materials at the base of the bluff along the eastern county boundary.

Use of Soil Map

The soil map is a complete sketch of the farm the same size as AAA photograph (scale: 8 inches - 1 mile). All important soil types, as well as rivers, drains, and artificial features, such as roads, houses, ditches, and section lines, are shown. (See "Legend of symbols on the soil map," page 7.) The number in each separate area on the map is the symbol for the soil type in that area. (See "Management by Soil Type," starting on page 14, for soil name and recommendations.) The letter following a soil number indicates the slope of the soil.

The soil map is used to determine the best location of field boundaries and roads, and to determine the soil type in each area. The slope and type of the soil, along with size and shape of the area, should determine the proper row direction.

Field Boundaries and Roads. Where practicable, field boundaries should be placed on soil boundaries that separate distinctly different soils. Then each field will contain only the soils that respond to the same management. Rotations, fertilizer treatments, and other management practices that are suitable for the entire field can then be planned.

Dotted lines indicate the approximate location of gradual changes between two soil types. They do not mean that field divisions should be made at that place unless the types of soil separated respond to different management. (See "Management by Soil Type," starting on page 14.)

Solid lines indicate the location of a rather sharp change between two soil types that usually respond to different management practices. Field boundaries should be located on most solid line soil boundaries. There are a few exceptions, such as the better drained depressional soils. (See "Management by Soil Type," starting on page 14.)

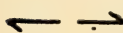
Roads usually serve as field boundaries and should be placed on soil boundaries where possible. Located on soil boundaries, they utilize the space left for turning that is ordinarily wasted. The boundaries of soils with B, C, or D slopes, as well as escarpments and bayou banks, are ideal locations for roads.

LEGEND OF SYMBOLS ON THE SOIL MAP

457. Soil type number denotes a soil type or complex of types in that area where the number is placed. (See "Management by Soil Type", page 14, for soil type names.)
- 457A. The letter following the soil number indicates the slope of the area. The absence of a letter or the use of A shows that the area is depressionial (no erosion problem); A° - nearly flat (no erosion problem); A - slightly sloping, ¼ percent to 2 percent, (very little erosion problem); B° - used only for colluvial soils occurring at the bottom of slopes (very little erosion problem); B - ridges or gently sloping, 3 percent to 5 percent, (erosion problem); C - sloping, 6 percent to 10 percent, (erosion problem); D - steeply sloping, over 10 percent, (erosion problem).
- *457A. An asterisk (*) before a soil type number indicates an organic phase of that type. The organic phase is more productive than the normal phase.

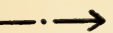
 Solid line soil boundary indicates the location of a definite soil change within a space of less than 50 feet (usually a desirable location for a field boundary).

 Dotted line soil boundary indicates a gradual or indefinite soil change within a space of 50 feet or more.

 Tie symbol that connects two areas of the same soil type or phase.

 Small natural drain or low area.

 Shallow artificial ditch not crossable with heavy farm machinery.

 Deep ditch (artificial or natural) not crossable with heavy farm machinery.

 River or large drainageway (artificial or natural).

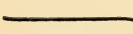
 Lake containing water all year.

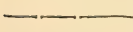
 Intermittent lake that is dry during a portion of the year.

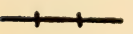
 Earth escarpment or steep embankment (too steep for cultivation).

 Levee

 Paved highway

 Gravel highway

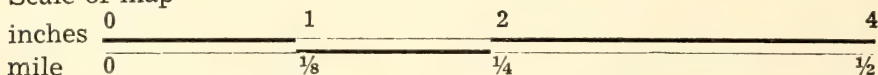
 Dirt road or field road

 Railroad

 Section line

Sec. 1	Section number
R. 10 W.	Range symbol
T. 5 S.	Township symbol
— — — — —	County line
■	Permanent house
■	Small house or cabin
✝	Church
🏫	School
🏪	Store
🌱	Cotton gin
⊕	Indian mound
⌚	Cemetery
∴	Sandy spot
🌊	Bluff symbol

Scale of map



GENERAL SOIL MANAGEMENT

This discussion of soil management is applicable to all soils in the Tunica County area. It deals with general principles which are fundamental for efficient soil use regardless of the type of soil. Specific recommendations for each soil type are given under "Management by Soil Type" (see page 14.) Table 1 contains estimates of cotton and corn yields that may be expected on each soil type where good management practices are used continuously. Many of these yields will be exceeded where good management practices are used for a number of years.

Drainage: Many Tunica County soils require artificial drainage before proper utilization is possible. In all cases involving extensive ditching, the productive capacity, crop adaptation, and fertilizer needs of the soil should be considered before going to the expense of draining. Many swampy areas have been drained where the cost was much more than the possible value of the land affected.

All ditches should be limited to the least possible width and depth that will provide sufficient drainage during any growing season. Drainage channels should be located in, or connected with, the natural low depressions in the area. The ditch banks should be plowed down as level as possible and cultivated whenever practical. Alfalfa and other hay crops give excellent yields on many ditch and canal banks. Alfalfa and sweet clover will usually grow on banks that contain lime concretions (gray or white rock-like objects).

Table 1. Key to management classes and yields produced on Tunica County soils with good management¹

Soil type (or phase)		Management class	Yields per acre	
No.	Name		Cotton Lint (lbs.)	Corn (bu.)
Soils derived from Mississippi River alluvium				
125 A	Mhoon silt loam	I	450	45
134 A	Commerce-Tunica complex	I	450	45
135 A	Commerce silt loam	I	700	65
345 A	Commerce silt loam (shallow phase)	I	675	50
136 A	Commerce loam	I	800	75
156 A	Robinsonville loam	I	800	75
157 A	Robinsonville sandy loam	I	700	45
167 A	Crevasse sandy loam	I, V	300	20
212	Dowling clay ²	IV	.....	.....
213	Dowling silty clay ²	IV	.....	.....
223	Panther silty clay ³	IV	175	15
225	Panther silt loam ³	IV	250	20
235	Souva silt loam	I	425	40
*235	Souva silt loam (organic phase)	I	500	50
235 B ⁻	Souva silt loam (colluvial phase)	I	600	55
256	Oakwood loam	I	700	65
*256	Oakwood loam (organic phase)	I	725	75
311 A	Horseshoe heavy clay	II	275	20
322 A	Sharkey clay	II	425	20
322 A(A ⁻)	Sharkey-Tunica-Panther complex ³	.....	.....	.....
322 A ^o (A ⁻)	Sharkey-Panther complex ³	.....	.....	.....
333 A	Tunica silty clay	II	550	25
133 A	Tunica silty clay (shallow phase)	II	600	30
344 A	Tunica-Dundee complex	II	625	35
424 A	Forestdale silty clay loam	III	425	20
425 A	Forestdale silt loam	III	475	25
434 A	Dundee silty clay loam	III	450	20
435 A	Dundee silt loam	I	600	55
*435 A	Dundee silt loam (organic phase)	I	700	65
436 A	Dundee loam	I	725	65
*436 A	Dundee loam (organic phase)	I	800	75
445 A	Dubbs silt loam	I	600	55
*445 A	Dubbs silt loam (organic phase)	I	750	65
446 A	Dubbs loam	I	725	65
*446 A	Dubbs loam (organic phase)	I	800	75
456 A	Bosket loam	I	750	65
*456 A	Bosket loam (organic phase)	I	825	75
457 A	Bosket sandy loam	I	750	65
*457 A	Bosket sandy loam (organic phase)	I	825	75
467 A	Clack sandy loam	I, V	300	20
468 A	Clack loam sand	V	100	10
Soils derived from mixed Mississippi River and Coldwater River alluvium				
534 A	Crenshaw silty clay loam	III	425	25
535 A	Crenshaw silt loam	I	700	60
612	Dooley clay ²	IV	.....	.....
613	Dooley silty clay ²	IV	.....	.....
623	Buxton silty clay	IV	150	15
625	Buxton silt loam	IV	225	20
635	Cannon silt loam	I	400	40
722 A	Savage clay	II	425	20
722 A(A ⁻)	Savage-Prichard-Buxton complex ⁴	.....	.....	.....
722 A ^o (A ⁻)	Savage-Buxton complex ⁴	.....	.....	.....

Table 1. Key to management classes and yields produced on Tunica County soils with good management¹ (Continued)

Soil type (or phase)		Manage- ment class	Yields per acre	
No.	Name		Cotton Lint (lbs.)	Corn (bu.)
Soils derived from mixed Mississippi River and Coldwater River alluvium				
733 A	Prichard silty clay	II	550	25
744 A	Prichard-Tibbs complex	II	600	30
824 A	Sarah silty clay loam	III	400	20
825 A	Sarah silt loam	III	450	25
834 A	Tibbs silty clay loam	III	425	25
835 A	Tibbs silt loam	I	600	45
935 B ⁻	Wicker loam (colluvial soil)	I, III	500	40

¹These yields are estimated for soils on A slopes that are protected from river overflow by a levee. Soils not protected by a levee will produce higher yields except when damaged by flood. As a rule, soils on B slopes produce slightly lower yields than those indicated in this table. See pages 13 and 14 for management recommendations.

²Crops are often damaged by standing water. Where good surface drainage is possible, yields are about the same as for Panther silty clay.

³These areas are forested. See Sharkey, Tunica, and Panther yields.

⁴These areas are forested. See Savage, Prichard, and Buxton yields.

Soils which have 3, 4, 5, or 6 as the middle number in their symbol should have shallow drains in the associated depressions that will take off excess surface water, but will not interfere with cultivation. Soils which have 1 or 2 as the middle number in their symbols usually require frequent, rather deep ditches. Alfalfa will not grow satisfactorily in poorly drained areas unless ditches are provided to remove excess water.

Row Direction: Erosion problem, moisture conservation, drainage, tillage convenience, soil type, and slope of soil should be considered in determining the row direction in any field.

The rows on depressional soils (no letter following the soil number) and soils with A° slope should be run so as to provide the best possible drainage.¹ Where soil types identified by the symbols 125, 135, 136, 311, 322, 333, 344, 424, 425, 434, 435, 436, 534, 535, 722, 733, 744, 824, 825, and 835 have A slopes, rows should be run so that each has enough slope to carry its drainage water to a ditch or other outlet. Rows should never be run so that the slope is steep enough to cause harmful erosion. On soil types identified by the symbols 156, 157, 167, 445, 446, 456, 457, 467, and 468, rows should be run on the contour (with the slope—not up and down) so that each row will hold the water that falls on it. Little drainage water should be allowed to run from these soils to more poorly drained soils. The rows on all B⁻, B, C, and D slopes should be run on the contour.

¹See "Legend of Symbols on the Soil Map," page 7, for the percentage of slope indicated by each capital letter slope symbol.

Nitrogen and Organic Matter. Most farmers have recognized the necessity of adding nitrogen and organic matter to their soils. On all except depressional soils or soils that are overflowed at least once in every 3 or 4 years, nitrogen and organic matter must be added to maintain maximum productivity of non-legume crops. Properly inoculated legume crops¹ in the rotation usually provide the cheapest and best source of both nitrogen and organic matter. Where this is not practicable, commercial nitrogenous fertilizers must be used on all non-legume crops if maximum yields are to be obtained.² A large surplus of nitrogen in the soil may cause excessive stalk growth of cotton and corn, thus reducing the yields.

Liming: If legumes cannot be grown successfully because of soil acidity, ground limestone should be applied. Soybeans, cowpeas, lespedeza, Austrian winter peas, and vetch have the lowest lime requirements of the legume crops. If these crops do not grow well and do not produce abundant nodules on the roots, lime should be applied to correct the acidity.

Any given soil type is rather uniform in its lime content, and general recommendations of amounts to apply can be made for each type. Before limestone applications are made on a large scale, simple acidity tests should be made on soil samples. (See county agent.) To produce alfalfa or sweet clover successfully, most low terrace soils must be limed. Amounts to apply will be discussed under the "Management by Soil Type." (See page 14.)

Ground limestone³ and basic slag are the most commonly used liming materials. Basic slag costs more than ground limestone per ton, but it contains an appreciable amount of phosphorus in which some soils are deficient. Limestone and basic slag are not immediately available to plants, so they should be applied several months beforehand where alfalfa, sweet clover, or any other leguminous crop is to be planted on an acid soil.

Phosphorus and Potassium: Experimental work with phosphorus and potassium carrying fertilizers on "delta" soils has been somewhat limited, and it is impossible to make specific recommendations for their use. Laboratory tests indicate the approximate content of phosphorus and potassium in a soil, but field tests are necessary before reliable recommendations can be made.

Phosphorus deficiency is most likely to occur in acid soils and in soils that have symbol numbers beginning with 8. Soil acidity should be corrected by liming before phosphatic fertilizers are used.

¹All legume crops (peas, beans, vetch, alfalfa, clovers) should be inoculated with commercial inoculants for the first and second plantings of each crop on any soil.

²See table 2 for composition of commercial fertilizers.

³Ground limestone of the best quality costs approximately \$3.00 per ton delivered in carload lots of 45 to 50 tons. (See county agent.)

Potassium deficiency is most likely to occur in sandy soils and in soil types that have symbol numbers beginning with 8. Soils that are deficient in potassium produce weak plants with slender stalks and stems. Rust or blight spots in cotton fields often indicate a deficiency of potassium in the soil.

Some soils or areas have no obvious limiting physical characteristics such as poor drainage or steep slopes, yet do not produce average yields for that type when recommended practices are followed. In such cases, farmers may determine the cause of the low yields by fertilizing a small area of about six rows with several different fertilizers. These tests are most likely to be needed on low terrace soils (400 and 800 groups) that are not organic phases. Yields from the fertilized plots should be carefully weighed, then compared with some adjoining plots of the same size that received no fertilizer. The county agent should assist in selecting the fertilizers and arranging the plots.

The removal of a hay crop depletes the soil of more calcium, potassium, and phosphorus than does a corresponding yield of cotton or corn. For example, a 2-ton crop of cowpea hay removes $2\frac{1}{2}$ times as much phosphorus, 12 times as much potassium, and 42 times as much calcium from the soil as a 1000-pound yield of seed cotton. Where possible, hay crops of lespedeza, soybeans, and cowpeas should be grown on the low bottom soils (300 and 700 groups, see page 18) or depressional soils (200 group, see page 17).

Pastures: Experimental work with pastures on Tunica County soil types has been very limited, but general management practices for good pasture production are similar for all regions. The soils that are best adapted to cotton and corn are usually the best adapted soils for pasture crops. The acreage of the first class soils is limited on most farms, so less productive soils are commonly used for pastures. Good management is essential to efficient use of any soil for pasture, but is seldom considered

Soils that have symbols ending in the numbers 1, 2, or 3 seldom make good pastures regardless of the management, but the soils that have symbols ending in the numbers 5, 6, or 7 usually make excellent pastures under proper management. Soils that have 6 as the middle number in their symbol must have special management as discussed under "Management by Soil Type," page 14. Acid soils should have at least 1000 pounds of ground limestone or basic slag applied per acre before seeding.

The seedbed should be well prepared and Dallis grass should be seeded in the early spring or fall if moisture is sufficient (6). Weeds should be clipped frequently during the first summer and grazing should be light or withheld altogether. A mixture of white dutch, black medic, and hop clovers should be sown in September, and common lespedeza should be sown early the following spring.

All pastures should be divided into at least two sections so that grazing can be alternated. Best results are obtained when pastures are not kept grazed close to the ground even if the livestock is allowed to graze only a few hours each day. Italian rye grass may be sown on top of the sod each fall for a winter and early spring pasture. It is usually advisable to have some temporary pasture, such as sudan grass or sweet clover, available for use during the late summer and early fall as no permanent pasture can be expected to support as much livestock during this period as in the other months of the growing season.

Table 2. Composition and availability of fertilizer materials

Fertilizer material	Nitrogen	Phosphorus (P ₂ O ₅ units)	Potassium (K ₂ O units)	Availa- bility
	Percent	Percent	Percent	
Nitrogen carriers:				
Nitrate of soda	16	.....	.....	Quickly
Sulphate of ammonia	20	.....	.....	Quickly
Calcium cyanamid	22	.....	.....	Medium
Phosphorus carriers:				
Superphosphate	....	18 or 20	.....	Quickly
Triple superphosphate	....	40 to 48	.....	Quickly
Basic slag	....	8 to 12	.....	Medium
Potassium carriers:				
Muriate of potash	....	.....	50 or 60	Quickly
Kainit	....	.....	20	Quickly
Manure salts	....	.....	20	Quickly
Complete mixtures:				
6-8-6	6	8	6	Quickly
4-8-8	4	8	8	Quickly

Cropping Systems Recommended for Use in Tunica County

For convenience in determining adapted cropping systems for soils in Tunica County, the soil types are grouped in five management classes on the basis of fertility, drainage, adapted crops, and workability. The class of each soil type is listed in table 1 on page 9.

The cropping systems for all classes are listed in table 3, page 14. A complete discussion of the management for each soil type is given under "Management by Soil Type", beginning on page 14.

All cropping systems are planned to maintain the most efficient production of adapted crops on a permanent basis. Cotton is considered the principal cash crop and is given the most favorable position in rotations for soils where it is adapted. Supplemental rotations are also given for each class in which grain or hay production, or both, are given consideration.

Table 3. Cropping systems recommended for Tunica County soils

Management class	Year	Rotations		
		Cotton (as often as possible)	Cotton and grain	Hay or hay and grain
I	1	Continuous cotton (plant vetch each fall)	Cotton (plant bur clover in the fall)	Fallow (plant alfalfa in the fall)
	2		Bur clover seed (plant corn in June)	Alfalfa
	3		Cotton	Alfalfa
	4		Cotton	Alfalfa
	5			Alfalfa
II	1	Cotton (plant vetch in the fall).	Soybeans (plant oats in the fall)	Oats (plant in the fall)
	2	Vetch seed (plant cowpeas or soybeans in June)	Oats (plant soybeans sweet clover, or lespedeza in the spring)	Oats (plant alfalfa in the fall)
	3	Cotton	Cotton	Alfalfa
	4	Cotton	Cotton	Alfalfa
	5			Alfalfa
	6			Alfalfa
III	1	Soybeans (turned under in the fall)	Soybeans (plant oats in the fall)	Soybeans (plant alfalfa in fall)
	2	Cotton (plant vetch in the fall)	Oats (soybeans, lespedeza, or sweet clover in the spring)	Alfalfa
	3	Vetch seed (plant cowpeas or soybeans in June)	Cotton	Alfalfa
	4	Cotton	Cotton	Alfalfa
	5	Cotton	Cotton	Alfalfa
IV	1			Soybeans (for hay)
	2	Cotton not recommended	Cotton not recommended	Soybeans (turned under and followed by oats)
	3			Oats (plant soybeans or lespedeza in spring)
V		Best adapted to drouth-resistant hay and pasture crops		

MANAGEMENT BY SOIL TYPE

This discussion covers drainage, crop adaptation, rotation, and fertilizer recommendations for each soil type. Fertilizer recommendations are omitted where no experimental work or apparent deficiency symptoms indicate a need for commercial fertilizers. Rotation and management recommendations are based on experiment station results, practices followed by the best farmers, and practices that should prove satisfactory under Tunica County conditions. Where there is a possibility that a crop or practice may not be adapted, a notation advises that it be tried on a small scale at first. Cotton is assumed to be the principal cash crop on all farms. The principles discussed under "General Soil Management," (see page 8), must be followed if best yields are to be obtained from any soil.

A. FIRST BOTTOM SOILS, GROUP 100 (derived from Mississippi River alluvium).

Soil type 125—Mhoon silt loam

This is a fertile and easily managed soil that needs artificial drainage for maximum production. A few small V-type ditches and one main outlet ditch usually drain an area satisfactorily.

This soil is well adapted to all local crops but is generally used for cotton and corn production. Most areas must have additional drainage before truck crops can be grown successfully. High yields of cotton and corn can be maintained if leguminous winter cover crops are grown. Bur clover and vetch are excellent winter crops for this soil. From 150 to 200 pounds of a nitrogenous fertilizer should be applied to corn and cotton if a leguminous cover crop is not grown (2 and 4).

Suggested cropping systems are:

Year	Rotation No. 1	Rotation No. 2	Rotation No. 3
1	Continuous cotton (plant vetch each fall)	Cotton (plant bur clover in the fall)	Fallow (plant alfalfa in the fall)
2		Bur clover seed (plant corn in June)	Alfalfa
3		Cotton	Alfalfa
4		Cotton	Alfalfa
5			Alfalfa

Unless the area is needed for cotton production every year, rotation No. 2 probably offers the best and cheapest way to insure good cover crops at a minimum cost. Alfalfa should not be planted where a thick stand of bur clover is likely to volunteer. Rotation No. 1 or No. 2 should be used on an area after rotation No. 3 is used.

Soil type 125 A (A⁻)—Mhoon-Panther complex¹

This complex of soils is unfit for agricultural use because of its low elevation and danger of overflow.

Soil type 133—Tunica silty clay (shallow phase)

This is a very fertile soil that responds to the same management as 322, Sharkey clay (see page 19), except that little artificial drainage is necessary. This soil will grow excellent alfalfa without lime applications. Deep plowing is desirable, as it brings sandy material to the surface in many cases.

Soil type 133 A (A⁻)—Tunica-Commerce-Panther complex¹

This complex of soils contains, for the most part, Tunica silty clay, shallow phase. Some areas are not overflowed for long periods of time. They are very fertile and are excellent for pastures

¹This complex of soils is not protected by the levee.

and hay production. Good corn can also be grown except when damaged by floods. It should be profitable to clear and cultivate the higher areas of this complex as high yields can be maintained without fertilizer additions or rotations, so long as overflows occur every few years.

Soil type 134—Commerce-Tunica complex

This is a very fertile soil that responds to the same management as 125, Mhoon silt loam (see page 15), except that little artificial drainage is needed and bur clover may be more difficult to grow. This is an excellent soil for alfalfa and oat production.

Soil type 134 A (A⁻)—Commerce-Tunica-Souva complex¹

This complex of soils contains, for the most part, Commerce silt loam and Tunica silty clay with some Souva silt loam. Many areas of this complex are very fertile and are not overflowed for long periods. Such areas are excellent for corn, hay, or pasture production. It should be profitable to clear and cultivate the higher areas of this complex, as high yields can be maintained without fertilizer additions or rotations, so long as overflows occur every few years.

Soil type 135—Commerce silt loam

This is a very fertile soil that responds to the same management as 125, Mhoon silt loam (see page 15), except that little artificial drainage is needed. It is an excellent soil for truck crop and alfalfa production as well as for cotton and corn.

Soil type 136—Commerce loam

This soil responds to the same management as 124, Mhoon silt loam (see page 15), except that little artificial drainage is needed. This is an excellent soil for truck crop and alfalfa production as well as for cotton and corn.

Soil type 136 A(A⁻)—Commerce-Robinsonville-Oakwood complex¹

This complex of soils contains, for the most part, Commerce loam and Robinsonville loam and sandy loam. This complex usually occurs on higher elevations than 134 A(A⁻), Commerce-Tunica-Souva complex (see above), but responds to the same management. These are the most desirable soils that occur in the area not protected by the levee.

Soil type 156—Robinsonville loam

This soil responds to the same management as 125, Mhoon silt loam (see page 15), except that no artificial drainage is needed. This is an excellent soil for truck crop and alfalfa production as well as for cotton and corn.

¹This complex of soils is not protected by the levee.

Soil type 157—Robinsonville sandy loam

This soil responds to the same management as 125, Mhoon silt loam (see page 15), except that no artificial drainage is needed. This is an excellent soil for truck crop and alfalfa production as well as for cotton and corn.

Soil type 167—Crevasse sandy loam

This is a very difficult soil to manage because of its "drouthy" nature. Crop yields are uncertain on this soil, so little cotton or corn should be grown. If cover crops are turned under frequently, and 100 to 200 pounds of sulphate of ammonia, nitrate of soda, or cyanamid are applied, fair yields of cotton and corn may be obtained. Ordinarily, drouth-resistant hay or pasture crops should be grown. Sudan grass, sagrain, soybeans, and cowpeas often produce good growth that may be used for either hay or pasture. Sweet clover should be planted for pasture and as a green manure crop on a trial area. Where a permanent pasture is desired, Bermuda grass, early clovers, and lespedeza should be used. Bur clover often makes good growth and should be used with cultivated crops. This soil can be used for bur clover seed patches, followed by corn or sudan grass. Black locust seedlings for fence post production should be grown on a small trial area. Soybeans may make fair yields of seed during favorable seasons.

Soil type 167 B(A⁻)—Crevasse-Oakwood complex¹

This complex of soils contains, for the most part, Crevasse sandy loam, which occurs on high elevations, but it is too sandy to cultivate profitably.

Soil type 169—Crevasse sand-clay complex¹

This complex of soils is unfit for any agricultural use because it is frequently overflowed by the Mississippi River.

B. DEPRESSIONAL SOILS, GROUP 200 (derived from Mississippi River alluvium).

Soil type 212—Dowling clay

This is a fertile soil that is difficult to manage because of its very poor drainage. Deep ditches must be provided before cultivation is possible.

This soil is adapted to soybeans, sagrain, sorghum, and sudan grass. Corn makes fair yields when the season is favorable, but may fail completely when moisture conditions are not satisfactory. A 100- to 200-pound application of a nitrogenous fertilizer should be applied when corn is grown if the soil has been in cultivation many years.

¹This complex of soils is not protected by the levee.

For row crops, this soil should be bedded with three furrows early in the fall and left until spring.

Soil type 213—Dowling silty clay

This is a fertile soil that responds to the same management as 212, Dowling clay (see page 17). Without artificial drainage this soil remains under water most of the year and normally supports cypress or tupelo gum tree growth.

Soil type 214—Dowling-Panther complex¹

This complex of soils consists of large swamps and depressional areas and is unfit for agricultural use.

Soil type 223—Panther silty clay

This soil responds to the same management as 212, Dowling clay (see page 17), except that shallow ditches often provide adequate drainage. Cotton and corn occasionally make fair yields.

Soil type 225—Panther silt loam

This soil responds to the same management as 212, Dowling clay (see page 17), except that shallow ditches often provide adequate drainage and it is better adapted for cultivated crops. Cotton and corn often make fair yields.

Soil type 253—Souva silt loam

This soil can ordinarily be used to best advantage when it receives treatment similar to that of the bordering soils. Shallow ditches are needed to obtain good drainage except when it is on a B⁻ slope. It is not necessary to follow rotations on this soil, and applications of commercial fertilizers should be light. Rows should usually be arranged to run in the same general direction as the strips of soil. This permits these areas to be planted and cultivated when they have the proper moisture content without having to delay or disrupt cultivation of the remainder of the field. An arrangement of rows such as this prevents a concentration of drainage water in the depression where it is not needed and helps avoid poor crop stands. Soil type *235—Souva silt loam (organic phase) has higher fertility than is usual for normal Souva silt loam.

Soil type 256—Oakwood loam¹

This soil responds to the same management as 235, Souva silt loam and *235, Souva silt loam (organic phase). (See above).

C. LOW BOTTOM SOILS, GROUP 300 (derived from Mississippi River alluvium).

Soil type 311—Horseshoe heavy clay

This is a fertile soil that is limited in productivity by character-

¹This complex of soils is not protected by the levee.

istics due to its fine texture (heavy clay), its low position, and poor internal drainage. Frequent ditches are necessary to provide satisfactory drainage.

Alfalfa, soybeans, and sorghums are adapted crops for this soil. Cotton usually makes fair yields and oats make good yields if they are fertilized with 150 to 200 pounds per acre of a nitrogenous fertilizer (2 and 4). If alfalfa is to be grown on this soil, 2 tons of ground limestone should be applied per acre. Some areas produce good alfalfa without limestone applications. The soil should be fallowed for most of the summer and then planted to alfalfa in September. For best yields, cotton, oats, and sorghum should follow a crop of soybeans or alfalfa that has been plowed under. Corn should be planted only on "new ground" and on areas where alfalfa or soybeans have been turned under.

Soil type 322—Sharkey clay

This is a fertile soil that is limited in productivity by characteristics due to its fine texture (clay) and its poor internal drainage. Frequent ditches are necessary to provide satisfactory drainage for this soil where it has either A or A° slopes.

Soybeans, oats, cotton, vetch, Austrian winter peas, and alfalfa are adapted crops for this soil. Corn should not be grown except on "new ground" or areas where heavy crops of legumes have been plowed under. Sweet clover is adapted where the soil is neutral or alkaline and should be tried on a small scale as a pasture and green manure crop. Alfalfa should not be planted on poorly drained areas unless adequate drainage ditches are provided.

Cotton and oats should be fertilized with 150 to 200 pounds of nitrogenous fertilizer unless a leguminous crop has been turned under the preceeding year (2 and 4).

Suggested cropping systems are:

Year	Rotation No. 1	Rotation No. 2	Rotation No. 3
1	Cotton (plant vetch in the fall)	Soybeans (plant oats in the fall)	Oats (plant in the fall)
2	Vetch seed (plant cowpeas or soybeans in June)	Oats (plant soybeans, sweet clover, or les-pedeza in the spring)	Oats (plant alfalfa in the fall)
3	Cotton	Cotton	Alfalfa
4	Cotton	Cotton	Alfalfa
5			Alfalfa
6			Alfalfa

These rotations are arranged to provide sufficient green manure crops to maintain a satisfactory content of organic matter and nitrogen in the soil. The presence of organic matter in large quantities makes cultivation of this soil easier and will raise the productivity level.

¹The presence of the organic phase symbol (*) in front of this soil number denotes higher fertility than is usual for this soil type.

In the second year of rotation No. 1, the vetch stubble and straw should be turned under as soon as the vetch seed are harvested, and cowpeas or soybeans should be planted. In the fall, the cowpeas or soybeans should be turned under before frost and the land bedded.

In rotation No. 2, soybeans should be turned under in late July or early August, and the oats planted in October. In early spring, soybeans, lespedeza, or sweet clover should be drilled in the oats and then turned under in the fall when maximum growth has been reached. It may be desirable in some cases to harvest the soybean or lespedeza seed with a combine and then plow under the stubble and straw. The soil should be left on beds or "lands" through the winter.

In rotation No. 3, the oats should be harvested in early summer, then the soil should be turned as deeply as practical with a pan or flat-bottomed breaking plow and fallowed until early fall. If the soil is acid, 2 tons of ground limestone should be applied after the oats are harvested (see county agent). Before alfalfa is planted, the field should have surface drains plowed out with a grader, plow, or single disk section. These drains should be used on most A slopes and on all A° slopes and should be placed every 20 or 30 feet for satisfactory surface drainage.

After 3 or 4 years, when the alfalfa stand has become thin, the field should be plowed in August and prepared for winter oats. Cotton or corn should be grown for two or three years after alfalfa has been plowed under. Then either rotation No. 1 or No. 3 should be used before reseeding the area to alfalfa.

Soil type 322 A(A⁻)—Sharkey-Tunica-Panther complex

This complex of soils contains gently undulating, forested ridges and poorly drained depressions. The predominating soils are 322, Sharkey clay, with 212, Dowling clay; 213, Dowling silty clay; and 223, Panther silty clay. Small areas of 424, Forestdale silty clay loam, and 333, Tunica silty clay, are also included. After these areas are cleared, corn or cotton can be grown continuously until yields start dropping. Then, the soils will respond to the same management as 322, Sharkey clay (see page 19), and 212, Dowling clay (see page 17).

Soil type 322 A°(A⁻)—Sharkey-Panther complex

This complex of soils is similar to 322 A(A⁻), Sharkey-Tunica-Panther complex (see above), except that the topography is nearly flat and there is no 333, Tunica silty clay, in the area. Extensive drainage systems are usually necessary before these areas can be cultivated successfully. When properly drained, these soils will respond to the same management as 322, Sharkey clay (see page 19), and 212, Dowling clay (see page 17).

Soil type 333—Tunica silty clay

This soil responds to the same management as 322, Sharkey

clay (see page 19), except that little artificial drainage is necessary. Most areas can be adequately drained by a few small ditches.

Soil type 334—Low bottom escarpment

This soil is similar to 322, Sharkey clay (see page 19), except that it occurs on steep slopes and requires no artificial drainage. Wherever possible, this soil should be put into a permanent pasture and seeded with white clover, lespedeza, and dallis grass. If the slope is smooth enough for mowing, alfalfa hay can be grown. Two tons of ground limestone should be applied per acre before alfalfa is planted. If cultivated crops are grown, rows should be run on the contour rather than up and down the slope.

Soil type 341—Tunica-Dundee complex

This soil responds to the same management as 322, Sharkey clay (see page 19), except that little artificial drainage is necessary. Some of the areas are sandy and suitable for corn and truck crop production. In this case, management suggestions made for 424, Forestdale silty clay loam (see below) are applicable.

Soil type 345—Commerce silt loam (shallow phase)

This soil responds to the same management as 125, Mhoon silt loam (see page 15), except that some areas are not well adapted to truck crop production if the underlying clay is close to the surface. Rows on sloping areas should be run on the contour so that erosion will not remove the surface soil and expose the underlying clay.

D. LOW TERRACE SOILS, GROUP 400 (derived from Mississippi River alluvium).

Soil type 424—Forestdale silty clay loam

This soil is low in fertility and requires careful management to produce profitable returns. Frequent small drains leading to fairly deep outlet ditches are necessary to provide adequate drainage where this soil has an A slope. No artificial drainage is necessary where this soil has a B slope.

Soybeans, oats, cotton, Austrian winter peas, and vetch are fairly well adapted to this soil. Corn should not be grown except on "new ground", or areas where large quantities of organic matter have been plowed under. Alfalfa and sweet clover are usually adapted to this soil if 2 tons of ground limestone per acre are applied. Alfalfa should not be planted on areas where the water table remains high or where there is no surface drainage. Sweet clover should be used as a pasture and green manure crop if it is adapted.

Cotton and oats should be fertilized with 150 to 200 pounds of a nitrogenous fertilizer unless a good crop of soybeans, sweet clover, or alfalfa has been turned under (2 and 4).

Suggested cropping systems are:

Year	Rotation No. 1	Rotation No. 2	Rotation No. 3
1	Soybeans (turned under in the fall)	Soybeans (plant oats in the fall)	Soybeans (plant alfalfa in fall)
2	Cotton (plant vetch in the fall)	Oats (soybeans, lespedeza or sweet clover in the spring)	Alfalfa
3	Vetch seed (plant cowpeas or soybeans in June)	Cotton	Alfalfa
4	Cotton	Cotton	Alfalfa
5	Cotton	Cotton	Alfalfa

The above rotations are similar to those recommended for soil type 322, Sharkey clay (see page 19), and the individual crops should be managed in the same way.

Because of low fertility, soybeans are included in rotation No. 3 to insure good growth of the alfalfa. The soybeans should be turned under in July or early August and the soil fallowed until September when the alfalfa is planted.

Soil type 425—Forestdale silt loam

This soil is low in fertility but is responsive to good management. Small drains leading to shallow outlet ditches should be used to drain this soil where it has an A slope.

All local crops are fairly well adapted to this soil after adequate surface drainage is provided. Two tons of lime per acre should be applied if alfalfa or sweet clover is to be grown. One ton of lime per acre should be applied where soybeans and winter cover crops are grown. Cotton and corn may give profitable response to applications of a complete fertilizer. A small area should be fertilized in order to determine its effect (see county agent). Cotton and corn should be fertilized with 200 pounds of a nitrogenous fertilizer unless a good legume crop has been plowed under (2 and 4).

Suggested cropping systems are:

Year	Rotation No. 1	Rotation No. 2	Rotation No. 3
1	Soybeans (plant vetch or bur clover in fall)	Cotton (vetch or bur clover in the fall)	Soybeans (plant alfalfa in fall)
2	Vetch or clover seed (plant corn in June)	Clover seed (followed by corn)	Alfalfa
3	Cotton	Cotton	Alfalfa
4	Cotton	Cotton	Alfalfa
5	Cotton	Soybeans	Alfalfa
6		Oats (lespedeza, sweet clover, or soybeans)	Corn

In rotation No. 1, seed may be harvested from the soybeans before the straw and stubble are plowed under. However, best results will be obtained from the succeeding crop if the soybeans are plowed under while green. Following winter cover crops, corn should not be planted until the cover crop has matured enough seed to reseed itself the following fall, or in the case of bur clover, it may be desirable to harvest a seed crop.

In rotation No. 3, soybeans should be plowed under during the latter part of July and the land fallowed until early September. Alfalfa should be planted in September whenever moisture conditions are favorable. Excellent yields of corn and cotton are produced following alfalfa, so rotation No. 2 should be used for 6 years.

Winter cover crops should be planted on this soil when possible. If winter crops are grown, the land should be disked thoroughly and bedded at least 2 weeks before cotton is planted. Where winter cover crops are not grown, this soil should be flat broken and bedded, or disked and bedded in the late fall or early winter.

Soil type 434—Dundee silty clay loam

This soil responds to the same management as 424, Forestdale silty clay loam (see page 21), except that less artificial drainage is necessary.

Soil type 435—Dundee silt loam¹

This soil responds to the same management as 425, Forestdale silt loam (see page 22), except that less artificial drainage is necessary. Also, this soil is adapted to truck crop production. The organic phase of Dundee silt loam (*435) responds to the same management as 125, Mhoon silt loam (see page 15), except that little artificial drainage is necessary.

Soil type 436—Dundee loam¹

This soil responds to the same management as 125, Mhoon silt loam (see page 15), except that little artificial drainage is necessary, and it is well adapted for truck crop production. One ton of ground limestone should be applied before alfalfa is grown.

Soil type 445—Dubbs silt loam¹

This is a moderately fertile soil adapted to all crops. It responds to the same management as 125, Mhoon silt loam (see page 15), except that no artificial drainage is necessary. On the most infertile areas, rotations suggested for soil type 425, Forestdale silt loam (see page 22), should be used. Two tons of ground limestone should be applied per acre where alfalfa or sweet clover is to be grown. If soybeans and winter cover crops do not grow well, one ton of lime should be applied per acre.

Soil type 446—Dubbs loam¹

This is a fertile soil adapted to all crops. It responds to the same management as 125, Mhoon silt loam (see page 15), except that no artificial drainage is necessary. A ton of ground limestone per acre should be applied for alfalfa or sweet clover unless the soil is an organic phase.

¹The presence of the organic phase symbol (*) in front of this soil number denotes higher fertility than is usual for this soil type.

Soil type 447—Terrace escarpment (sand and clay beds)

This soil occurs on slopes similar to those of 334, low bottom escarpment (see page 21), and responds to the same management. Some areas make excellent bur clover seed patches. This soil with a C slope often produces good yields of all crops. Bur clover or vetch should be grown when this soil is used for cotton or corn production.

Soil type 456—Bosket loam¹

A fertile soil that responds to the same management as 125, Mhoon silt loam (see page 15), except that no artificial drainage is necessary. This is one of the most productive soils in the county. The organic phase (*456) is unsurpassed in productivity.

Soil type 457—Bosket sandy loam¹

This soil responds to the same management as 125, Mhoon silt loam (see page 15), except that no artificial drainage is necessary. The organic phase (*457) is unsurpassed in productivity.

Soil type 467—Clack sandy loam

This soil responds to the same management as 167, Crevasse sandy loam (see page 17). A 1000-pound application of ground limestone every 5 years may increase the growth of legumes.

Soil type 468—Clack loamy sand

This soil is extremely "drouthy" and no row crops should be grown. The drouth-resistant pasture crops suggested for 167, Crevasse sandy loam (see page 17), are recommended for use on this soil. It is unsuitable for anything but pasture, hay, and timber growth. Black locust seedlings for fence post production should be grown on a small area to determine their adaptability.

E. FIRST BOTTOM SOILS, GROUP 500 (derived from Coldwater River alluvium or mixed Mississippi and Coldwater River alluvium).

Soil type 534—Crenshaw silty clay loam

This is a moderately fertile soil that overflows frequently unless it is protected by levees or diversion channels. A few small ditches will provide adequate drainage for most areas except during floods.

This soil where protected from overflow, is adapted to all local crops. Cotton or alfalfa should not be grown if there is danger of annual overflow. Corn, soybeans, and sorghum make good growth without fertilizer so long as overflows are frequent enough to maintain soil fertility. Where this soil is protected by a levee, it will

¹The presence of the organic phase symbol (*) in front of this soil number denotes higher fertility than is usual for this soil type.

respond to the same management as soil type 424, Forestdale silty clay loam (see page 21). Two tons of ground limestone should be applied per acre before alfalfa is planted.

Soil type 535—Crenshaw silt loam

This is a moderately fertile soil that is very responsive to good management. Many areas of this soil overflow frequently, and should be used only for corn, soybeans, and sorghum. Artificial drainage of this soil is seldom necessary.

Where protected from overflow, this soil is well adapted for the growing of all local crops. It is an excellent soil for truck crop, cotton, and corn production. It will respond to the same management as 125, Mhoon silt loam (see page 15), except that phosphorus and potassium fertilizers may be needed to maintain maximum production permanently and little artificial drainage is necessary.

F. DEPRESSIONAL SOILS, GROUP 600 (derived from mixed Mississippi and Coldwater River alluvium).

Soil type 612—Dooley clay

This soil responds to the same management as 212, Dowling clay (see page 17).

Soil type 613—Dooley silty clay

This soil responds to the same management as 212, Dowling clay (see page 17), except that more extensive drainage systems are usually necessary.

Soil type 623—Buxton silty clay

This soil responds to the same management as 213, Dowling silty clay (see page 18), except that shallow ditches often provide adequate drainage. Cotton and corn occasionally make fair yields.

Soil type 625—Buxton silt loam

This soil responds to the same management as 213, Dowling clay (see page 18), except that shallow ditches often provide adequate drainage and it is better adapted for cultivated crops. Cotton and corn often make fair yields.

Soil type 635—Cannon silt loam

This soil responds to the same management as 235, Souva silt loam (see page 18).

G. LOW BOTTOM SOILS, GROUP 700 (derived from mixed Mississippi and Coldwater River alluvium).

Members of this group of soils are inundated by flood water more frequently than the corresponding members of group 300 (see page 18).

Soil type 722—Savage clay

This soil responds to the same management as 322, Sharkey clay (see page 19).

Soil type 722 A(A⁻)—Savage-Prichard-Buxton complex

This complex of soils is similar to 322 A(A⁻), Sharkey-Tunica-Panther complex (see page 20), and responds to the same management.

Soil type 722 A^o(A⁻)—Savage-Buxton complex

This complex of soils is similar to 322 A^o(A⁻), Sharkey-Panther complex (see page 20), and responds to the same management as 322, Sharkey clay (page 19).

Soil type 733—Prichard silty clay

This soil responds to the same management as 322, Sharkey clay (see page 19).

Soil type 744—Prichard-Tibbs complex

This complex responds to the same management as 344, Tunica-Dundee complex (see page 21) or 322, Sharkey clay (see page 19).

H. LOW TERRACE SOILS, GROUP 800 (derived from mixed Mississippi and Coldwater River alluvium)

Soil type 824—Sarah silty clay loam

This soil responds to the same management as 424, Forestdale silty clay loam (see page 21). It is possible that alfalfa or sweet clover will not grow well on some of this soil, so it is advisable to plant a very small area to determine its adaptability. Some areas of this soil are inundated by flood water occasionally.

Soil type 825—Sarah silt loam

This soil responds to the same management as 425, Forestdale silt loam (see page 22). An application of a complete fertilizer (6-8-6) or a potassium-carrying fertilizer may give profitable response when applied to corn or cotton. Small areas should be fertilized with each fertilizer (see county agent). Six hundred pounds of basic slag or 1 or 2 tons of ground limestone per acre should be applied to this soil before alfalfa or sweet clover is planted.

Soil type 834—Tibbs silty clay loam

This soil responds to the same management as 434, Dundee silty clay loam (see page 23).

Soil type 835—Tibbs silt loam

This soil responds to the same management as 425, Forestdale silt loam (see page 22), except that less artificial drainage is necessary and it is adapted to truck crop production.

Soil type 935B⁻—Wicker loam (colluvial soil)

This soil responds to the same management as 835, Tibbs silt loam (see page 26).

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STATE COLLEGE, MISS.

PROBLEMS IN THE TRANSPORTATION OF MILK FROM FARMS TO MILK PLANTS



MISSISSIPPI AGRICULTURAL EXPERIMENT STATION
STATE COLLEGE, MISSISSIPPI

CLARENCE DORMAN, Director

THE economic well-being of farm producers is affected directly and materially by the relative efficiency of the marketing process which includes transporting, processing, and storage of commercial farm products. The proportion of the consumer's dollar that goes to the "middle man" has been on the increase for the past several years. It is very important, therefore, from the viewpoint of rural economy that the farm marketing system and its operation be carefully and objectively appraised.

This bulletin is the first of a series of Experiment Station publications that are now in the process of development or in the planning stage, dealing with various aspects of marketing problems in Mississippi. This study was designed for the purpose of providing objective data on the transportation of milk from the farms to processing plants in the Northeast Mississippi milk shed. Transportation problems growing out of wartime stringency of facilities and materials accounts for the study. It was expected that the information would be used by operators and government agencies in effecting efficiencies and economies in the transportation of milk.

Appreciation is extended to the General Education Board for supplementary funds that have made this study possible. Acknowledgement is made to Dr. D. Gray Miley for suggestions in the organization and development of the study and for critically appraising the manuscript. Appreciation is also extended to the field representatives and managers of the milk processing plants truck drivers, and dairy farmers who provided much of the information that made this study possible.

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PROBLEMS IN THE TRANSPORTATION OF MILK FROM FARMS TO MILK PLANTS

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In 1939 there were 2.4 cows milked per farm in the State of Mississippi, with only 0.1 cow per farm increase over the number of cows milked per farm in 1930. Only 65.9 percent of the farms in Mississippi reported cows milked. The average number of gallons of milk produced per cow in 1940 was 329. Based on a lactation period of 10 months, the average number of gallons of milk produced per day per cow would be approximately 1.09.

In the Oktibbeha dairy area and in the Mississippi-Alabama Black Prairie area there were 4.1 cows milked per farm in 1939. Seventy-eight percent of the farms in this area reported cows milked. The average number of gallons produced per cow per year was 334, or a daily average of 1.31 gallons.

From this data it would be assumed that the dairying in the Oktibbeha dairy area and in the Mississippi-Alabama Black Prairie area is carried on as a part of the farm set-up. The dairy enterprise on the farms is one of the combination of enterprises including cotton, other crops, livestock, and pasture.

The principal markets for the milk produced on the farms in this area are condenseries, cheese plants, and creameries. These plants are well distributed throughout this area. Condenseries are located at Tupelo, Starkville, and Macon. The condensery at Tupelo has cooling stations at Baldwyn and Okolona. The condensery at Starkville has a receiving station at Artesia. Cheese plants are located at Okolona, Houston, Columbus, Brooksville, and Maben. A combination cheese plant and creamery is located at West Point, and a co-operative creamery is operating at State College. There is one dairy plant at Columbus owned by a few farmers in that vicinity and operated on a cooperative basis. Also located at Columbus is a creamery that buys milk from a few farmers producing Grade A milk. A privately owned creamery is located at Amory. There was a cooperative creamery operating at Macon which has become defunct and is now being changed to a cheese plant.

All milk is purchased on a butterfat basis and is rejected on the factors of excess acidity, excess sediment and off flavors. The condenseries set their prices paid for milk on the Evaporated Milk Industry Code which is approved by the United States Department of Agriculture.¹ Cheese plants base their prices on the Chicago and Plymouth Cheese Market prices. The creameries pay for milk and cream on the basis of the Chicago market for 92 score butter.

In addition to the purchasing of milk from farmers, the milk plants usually operate a side-line business of selling dairy feeds and other dairy supplies such as strainers, strainer pads, milk cans, washing powders and other items. Farmers sending milk to the plants may make daily orders for these supplies through milk route operators, and are extended credit for such items by the milk plants for the periods between financial settlement.

The various organizations operating these plants have fully realized the necessity of working with the farmers in developing the dairy industry in this area. The plants employ field men acting in the same capacity as extension specialists and devoting their entire time to developments and improvements in the trade areas of their respective plants. Much work has been done to increase milk production by improving the quality of the dairy cattle and by improving the practices of dairy husbandry. Development of new local areas of production is of further importance. The most intensive work being done by the field men is in the improvement of the quality of the milk. This phase of the work offers numerous difficult problems of great perplexity, especially with farmers who are lax in the precautions necessary to produce clean milk, whether they are lax in their personal handling of the milk or in the supervision of the milking operations.

Another phase of the marketing of milk which offers many problems is the transportation of milk from farms to plants. The transportation of milk from farms to milk plants becomes more of a problem daily because of increasing restrictions resulting from our war efforts. Selective service has taken its toll of men as operators and helpers on these routes. Men of normal physical stamina are being replaced by older men, physically less able and in many instances, physically unfit, to carry on the duties required in operating a milk route. In two instances, it was found that the routes are being operated by farm women, true soldiers without benefit of title of any form of women's auxiliary corps.

¹ Evaporated Milk Industry code as approved by the United States Department of Agriculture: "The minimum price to be paid for milk delivered to such evaporated milk plants during each month and used for the production of evaporated milk shall be calculated as follows—The average wholesale price per pound of 92 score butter at Chicago for said month as reported by the United States Department of Agriculture from which shall be deducted 2 cents (the resulting figure being termed in this schedule a flat butterfat value). The flat butterfat value shall be multiplied by 4 and to the figure thus obtained shall be added 30%, which resulting figure shall be the minimum price for 100 pounds of milk with a butterfat content of 4%, delivered to plants in the above states during such month. The minimum price paid for milk with a butterfat content below 4% shall be calculated on a direct ratio basis. For milk with a butterfat content above 4% the minimum price shall be that for milk of 4% butterfat content plus an extra payment for butterfat in excess of 4% on the basis of the flat butterfat value."

Taken from a statement of a report from one of the condenseries from which information for this study was obtained.

The rationing of automobiles, rubber, and gasoline has restricted the extent to which the milk routes can be operated. Because milk is entirely a perishable commodity and the restrictions imposed by our defense program are limiting factors in the transportation of milk from farms to plants, every effort possible should be made to increase the efficiency with which the milk trucks operate. It is of absolute necessity that the trucks comply with the defense regulations and, at the same time, transport every available pound of milk to the plants for processing into dairy products essential to the health and nutrition of the people of the United Nations and to their allied armed forces.

An investigation of the methods and problems involved in the marketing of milk by farmers to milk plants in the Black Prairie area and in the Oktibbeha dairy area of Mississippi is being conducted by the Department of Agricultural Economics of the Mississippi Experiment Station.

An analysis of the transportation of milk from farms to milk plants is one phase of this study.

The purpose of this phase of the milk marketing study is to determine both the physical and the financial problems involved in the transportation of milk from farms to plants.

Scope and Method of Study

The counties in which information was obtained include Oktibbeha, Clay, Noxubee, Lowndes, Chickasaw, and Lee. These counties were selected for the study on the basis of the concentration of milk plants in this area, as well as the large percentage of farm income that was derived from the sale of milk and cream.

The data on the transportation of milk were obtained from the plant managers, the records of the plants, the truck drivers, and an inspection of each truck.

Information was obtained by interviews with plant managers as to the relationship between the milk plants and the milk route operators, and the relationship between route operators and their patrons. The basis and rate of charges for hauling milk, the methods of payment, and the percentage of patrons hauling their own milk, were obtained. Plant managers were asked to name the major problems of transporting milk from farms and to indicate whether or not there is a possibility of farmers' having cooperative milk hauling associations.

The amount of milk hauled on each route per month, the number of patrons on each route per month, and the hauling charges of routes were also obtained. The routes for the various plants were drawn on county maps.

The information obtained from interviews with truck operators consisted of: a history of the truck, its make, model, size, condition of

tires, age of tires, cost of operation; the time required by the truck to make a round trip; and the length of the route.

The main objectives of this phase of the milk marketing study are: (1) to obtain a detailed knowledge of the transportation of milk and cream from the farms to the plants; (2) to determine the main problems involved in milk hauling; and (3) to make some suggestions that might be helpful in the alleviation and further study of the main problems of milk transportation.

Private Truckers Haul Milk

Plants do not operate their own trucks. The milk routes are operated by private owners, usually farmers living in the community of the area which they serve. Most of the plants have a contract with the truckers providing that the trucker shall haul the milk of a patron upon the agreed price, and that a change in the price of hauling requires a change in the contract between the trucker and the producer. The truckers solicit for their routes so as to increase their revenue from hauling; this serves as a benefit to the plants also. The relationship between the truckers and the patrons was reported as satisfactory in most cases by the plant managers. Some of the managers reported that a few patrons complain because truckers refuse to make side trips on bad roads to pick up milk; the plants rightfully uphold the truckers on this point.

Producers are charged for hauling on a hundredweight basis for milk and on a per pound basis for cream. The charges for hauling milk range from 10 to 50 cents per hundredweight, while cream is hauled at the rate of 2 cents per pound. The average price received for hauling milk is 22.8 cents per hundred pounds. Charges are not made on a mileage basis, but instead a flat rate per hundredweight of milk is the common practice. There is no seasonal fluctuation in the hauling charges; in fact, the charges for hauling have been very stable. The truckers are paid on the same basis as the farmers are charged. This transaction is performed by the milk plants as a free service to the truckers and the producers. Truckers receive their pay at the same time the producers receive their checks, twice a month. The plants deduct the hauling charges for each patron and pay the trucker this amount. Plants do not pay any part of the hauling charges. They do find it advisable at times to compensate small routes with a bonus in order to keep these routes operating during a period of low production.

The major problems in the hauling of milk as stated by the managers are: the rationing of tires, low volume routes, bad roads, and lack of personnel. The loss of patrons due to various reasons is also of primary importance in affecting the efficiencies with which milk routes operate. The various reasons for the loss of patrons are as follows: decrease in production, competition between plants, dissatisfaction of patrons due to rejected milk, and personal reasons causing patrons to change from one plant to another. None of the managers was of the opinion that a cooperative organization among

farmers to haul milk would be successful, although they all felt that such a program could be beneficial in numerous ways such as in developing an appreciation for the problems confronting the truckers, and in showing the many difficulties encountered in efficiently handling milk by truckers. Plant managers stated that their patrons failed to understand the numerous problems encountered by the truckers. One cooperative association in this area does have a cooperative trucking system owned by the patrons which has shown good results. However, as long as keen competition between plants in the various local areas exists, any such system for hauling milk would probably face defeat because of the instability of customers caused by their changing from one plant to another.

Approximately 10 percent of the patrons deliver their own milk to the plants. These are mostly producers living close to the plant, less than half of them being large producers. Table 1 shows the percentage of milk hauled by routes and the percentage delivered by individual patrons monthly for 1941.

The difference between the amount hauled by routes and the amount hauled by locals for June through October is quite noticeable in that the percentage of patrons hauling their own milk is larger than during the winter months. This is due to the increase in the milk production of farms near the plants, allowing these patrons to haul their own milk at a possible saving over what a trucker would charge.

Numerous small farms close to the towns where the plants are located have one or only a few cows. Because of the natural increase in milk production from June to October, it is to be expected that during this period these producers would have surplus milk, and that they would seek the milk plants as consumers of their surplus. In addition, many of the patrons habitually go to town more often during this period; therefore, in making these frequent trips, they haul their own milk.

Table 1—Percentage of milk hauled by routes and by locals¹
for nine milk plants in 1941

Month	Percentage hauled by routes	Percentage hauled by locals
January	94	6
February	90	10
March	90	10
April	91	9
May	93	7
June	87	13
July	89	11
August	86	14
September	88	12
October	78	22
November	97	3
December	87	13
Average	86	14

¹Locals—Patrons hauling their own milk to plants.

Bad Roads Cause Problems

Forty-six percent of the customers live on dirt roads, many of which are almost impassable in wet weather. Table 2 shows the number of routes reporting various percentages of customers living on the dirt roads.

Table 2—Distribution of customers by types of roads

Percentage of customers	Number of routes having customers living on dirt roads
Less than 10	15
10-19	9
20-29	4
30-39	13
40-49	11
50-59	16
60-69	3
70-79	8
80-89	8
90-99	6
100	14
Percentage of customers living on improved ¹ roads.....	54.00
Percentage of customers living on dirt roads.....	46.00

¹ Improved roads are paved roads and gravel roads.

These patrons living on dirt roads offer a most important problem to truckers, especially those living on roads impassable in wet weather. Some of the patrons haul their milk out to the main roads so the truckers can pick it up. Many patrons, however, expect a trucker to drive through any kind of mud and bog to pick up their milk regardless of how much or how little they are sending to the plant. One trucker is forced to increase the length of his route by 20 miles during wet weather because his usual route is entirely impassable at such times.

Use of Trucks

Eighty-nine percent of the men and women hauling milk from farms to plants also haul milk produced on their own farms in addition to that which they haul for the patrons on their routes. For 10 plants, there are 132 routes, with 139 trucks operating. Of the 132 routes, 14 hauled for patrons only, while 118 routes hauled milk produced on the operator's farm and also hauled for other patrons. All truck operators live in the communities from which they haul milk. They have become an institution of service on which their communities are steadily and increasingly becoming dependent. Combined with the hauling of milk is the backhauling of dairy feeds, farm supplies, ice, and miscellaneous items such as groceries and clothing for farmers. As a result of gasoline rationing, many patrons try to get rides to town on the milk trucks. In addition to milk, farm products such as livestock, corn, hay, and cotton must be moved to markets. Seed cotton must be taken to the gin and cottonseed must be delivered from the gins to the oil mills. Farm families moving to another farm call upon these local truckers to move their possessions. Dur-

ing the winter weather, the truckers are also asked to haul firewood to many farm homes. Milk trucks operating in defense areas often haul workers engaged in defense work to their places of employment.

Truckers are much concerned as to whether or not they can continue performing these numerous services while trying to conserve their trucks, tires, and gasoline to insure a continuation of the operation of the milk routes. The problems of refusing such types of hauling for one's neighbors are difficult and distressing, especially when the need for these services is so fully realized by the truckers themselves. Local rationing boards also realize the necessity for operations of these trucks other than the hauling of milk and are constantly trying to make allowance for such uses.

A small charge for this additional hauling is made on the basis of weight. The common rate charged for feed, fertilizer, and similar commodities is 10 cents per hundredweight. The usual charge for hauling seed cotton to the gin is \$1.50 per bale, and \$1.50 per ton for hay. Most of the feed is sold to the farmers as a side-line business of the milk plants. Bi-monthly settlements include the hauling charges for feeds hauled to the farmers as well as for the milk hauled to the plants. These charges are deducted from the patrons' milk checks and the trucker receives his money at the milk plant. Distance does not alter the rate charged for the hauling of feeds and similar articles. It was observed frequently that many milk trucks carry numerous passengers seated atop the milk cans. Only a few truckers reported a charge for hauling passengers, usually 10 cents a person. This type of covering is not the kind indicated by the Mississippi code which prescribes that milk trucks should be covered to protect the cans from weather and from unsanitary conditions. It hardly seems that such protection is afforded when passengers are allowed to sit atop the milk cans scraping their feet along the edges of the cans.

Inventory of Trucks

Sixty percent of the trucks in use were 1½-ton capacity; all had platform bodies, with only a few having the bodies enclosed. Trucks with enclosed bodies were found only at one plant. Most milk trucks are not covered in any manner, except in severely cold weather by tarpaulins. Seventy percent of the trucks were from 1 to 3 years old. The age and size of the trucks are shown below in table 3.

Complete data were obtained on 91 trucks for the number of months the trucks had been on the route and the number of miles on the trucks. These two factors show a very small degree of relationship as can readily be seen in table 4. There was no difference in the relationship of these factors with trucks purchased new from the data on all trucks. This indicates that milk trucks are used extensively to perform other transportation services in addition to the hauling of milk. Forty percent of the trucks hauling milk had been

Table 3—Size and model of trucks on milk routes, September 1942

Size of truck	Model of truck								Total
	1935	1936	1937	1938	1939	1940	1941	1942	
1/2 ton			1		1				2
3/4 ton				1	5	4	5	1	16
1-1/2 ton	1	7	3	2	6	22	26	8	75
Pick-up	1	2	2	2	8	1	7	3	26
Others									5
Total	2	9	6	5	20	27	38	12	124
Percentage	1.6	7.2	4.8	4.0	16.0	21.6	30.4	9.6	100

on the route for 6 months or less, showing a high degree of turnover in the ownership of milk routes. Milk routes are owned by the individual truckers, requiring a transfer of ownership on a financial basis.

Many route operators made the statement that they had purchased the milk route they were operating from the previous operator. In many instances, they also purchased the truck. Of interest, however, is the fact that even though the ownership of milk routes is considered as intangible, the operators have established their routes and have usually increased the volume of milk to be hauled. Consequently, they will not relinquish these holdings without being paid for the efforts they have put forth in establishing the routes.

Table 4—Number of months truck had been on route and the present mileage on trucks, September 1942

Miles on truck (thousands)	Months truck has been on route								Total and over
	1	6	12	18	24	30	36	42	
Number of trucks									
10-19	3		1						4
20-29	3	5	4						12
30-39	4	2	5	5		1		1	18
40-49	3	2	2	4	1				12
50-59	2	3	1	3	1	1	1		12
60-69	2	1	1		1	2			7
70-79	2			1					3
80-89		1	1	1	2	1		1	7
90-99					1			1	2
100 and over	2		3	1	2	3	2	1	14
Total	21	14	18	15	8	8	3	4	91
Percentage	23.1	15.4	19.8	16.5	8.8	8.8	3.3	4.3	100

With the average length of route being 54.6 miles, the mileage accrued by operating the milk routes for the same number of months as in table 4 is shown in table 5.

Trucks having been on the routes less than 6 months show a large amount of mileage not due to milk routes, indicating a large percentage of older trucks taking over these routes.

Table 5—The amount of mileage on milk trucks occasioned by the operation of milk routes and the amount occasioned by other factors

Number months on route	Number trucks	Total mileage on trucks	Number miles from operating routes	Mileage above amount for milk route	Average mileage above milk route for truck	Average amount per month for trucks above milk route mileage ¹
1	21	985,000	68,775	916,225	43,630	43,630
6	14	600,000	279,776	320,224	22,873	3,812
12	18	885,000	450,126	434,874	24,160	2,013
18	15	780,000	674,850	105,150	7,010	390
24	8	630,000	400,112	229,888	28,736	1,197
30	8	605,000	559,976	45,024	5,628	187
36	3	455,000	225,060	229,940	76,647	2,129

¹ This amount of mileage is not necessarily due to extra traveling each month in addition to the milk route mileage, but also includes mileage accumulated on trucks purchased second hand.

Condition of Trucks

The mileage and the mechanical condition of 105 trucks revealed that 53 percent of the trucks were in good mechanical condition, 31 percent were in fair mechanical condition, and 15 percent were in poor mechanical condition as stated by the truck drivers. Table 6 below shows the conditions of trucks with the trucks classed according to the mileage on the truck. Of especial importance is the fact that 15.14 percent of the trucks reported were in poor mechanical condition. Of this 15 percent, one-half had over a hundred thousand miles on them. These trucks hauled 6,000,000 pounds of milk per year. The ill effects that would result should the trucks become mechanically unable to continue operating would require a large scale route reorganization, or new trucks which are most difficult to obtain. Likewise, the other 84 percent of the trucks are depreciating in operating value as each month goes by. With the

Table 6—The mechanical condition of trucks classed by mileage on the trucks

Miles traveled (thousands)	Mechanical condition of trucks							
	Good		Fair		Poor		Total	
	No.	percent	No.	percent	No.	percent	No.	percent
10	4	7.1					4	3.8
20	11	19.6	1	3.1			12	11.5
30	13	23.2	8	24.1	2	12.3	23	21.9
40	9	16.1	3	9.1	1	6.0	13	12.5
50	9	16.1	6	18.2			15	14.3
60	2	3.1	3	9.1			5	4.8
70	2	3.7	3	9.1	2	12.3	7	6.7
80	2	3.7	4	12.1	2	12.3	8	7.6
90								
100	1	1.9	3	9.1	1	6.1	5	4.4
Over 100	3	5.5	2	6.1	8	50.9	13	12.5
Total	56	100.00	33	100.00	16	100.00	105	100.00
Percent total each group is of all trucks.	53.3		31.4		15.2		100	

possible war duration of more than another year, it is going to be extremely difficult to keep these trucks operating and to permit them to carry on the many duties they are now performing.

Truck Tire Situation

Of major interest at present is the condition of the truck tires. Information on the age, the mileage, and the condition of 274 tires was obtained. The average age of these tires was 10.6 months, the average distance traveled per tire was 23,065 miles, giving a monthly average of 2,183 miles. The range in mileage on the tires was from less than 2,000 miles to over 100,000 miles. The large variation in the mileage on the tires was shown to be present, and found to be due to factors other than those of mere chance. Normally it would be expected that the number of tires in the lower mileage groups would be in an equal proportion to the number of tires in the higher mileage groups while the tires in the center mileage groups would be the most numerous. This type of distribution would be expected for these reasons: (1) all trucks did not commence operating milk routes at the same time; (2) all trucks operating milk routes were not purchased new; many were purchased second-hand; (3) many farmers when purchasing tires for trucks will purchase a second-hand tire that has had slight use. However, the tires most numerous were those having traveled the least number of miles, and those having traveled the greatest number of miles. There were more tires in the group having traveled the lesser number of miles. This can possibly be attributed to the rationing of tires, causing the truckers that would have normally bought tires at an earlier date to postpone these purchases until they were sanctioned by the local rationing boards. A marked degree of relationship between the mileage on the truck tire and the age of the tire exists, which is normally expected. Therefore, the longer the tire has been on a truck, the more mileage one would expect that tire to have run.

It is not to be inferred that the tire situation of the milk trucks is without problems. The normally expected life of a tire on a milk truck is approximately 30,000 miles. With 28 percent of the tires having over 30,000 miles on them, it is easy to appreciate the problems of supplying tires for these trucks. Tires that are to be re-capped or retreaded must have enough rubber left on them to facilitate proper adherence of the additional rubber put on in these processes. Furthermore, it is necessary that the side-walls be in good physical condition, as tires with broken side-walls cannot be repaired. Only 50 percent of the trucks had spare tires, with half of these in such poor physical condition that they were beyond repair, making their usefulness in an emergency doubtful.

The tires with over 30,000 miles on them represent the group in the poorest condition. Many of these tires had been worn to the fabric and were beyond repair. Truckers were operating with tires that violated all principles of safe driving. Numerous tires were inspected that would make one wonder how that truck ever got the load of milk to the plant, and if the truck could possibly get back to

its garage. Truckers who had experienced using recapped tires were very pessimistic as to their success. Many truckers stated that recapped tires worked all right during cool weather, but that during hot weather, rapid breakdown took place and that adherence of recapped rubber to the old tires was not successful. An inspection of the recapped tires revealed that the loosening of the rubber was prevalent.

Truckers reported much distress caused by delays in getting a tire, either new or second-hand, when an emergency such as a blow-out warranted a permit to purchase one. In many of these instances it was found very difficult to get a load of milk to the plant while a milk truck had to await official action for a permit to secure a tire. A few truckers were even using borrowed tires.

Truckers operating milk routes by using a $\frac{1}{2}$ -ton pick-up with a platform body have reported much difficulty in securing tires for the purpose of operating the route, due to a ruling whereby pick-ups are included with passenger cars. This ruling is especially detrimental to the transportation of milk, when 21 percent of the milk routes are operated with pick-ups. Further importance of this ruling is the fact that at one plant having 15 routes, 9 are operated with pick-ups.

With tires being rationed and each county being allowed a quota, the conservation of the present tires is of utmost importance. Because of condition of tires on milk trucks it appears that reorganization of some routes and the shortening of all truck mileage as much as possible is a necessity. Every effort to eliminate each extra mile of driving should be made.

Variations in Milk Routes

The length of the milk routes ranged from less than 20 miles to 160 miles per round trip. Routes with a round trip distance of from 40 to 80 miles are the most numerous, with the average length of a route being 54.6 miles. With 64,000,000 pounds of milk being hauled per year by 117 routes, we have an average of 546,961 pounds per route being hauled, at the rate of about 1,000 pounds of milk per trip. Based on an average price of 22.8 cents per hundredweight, the trucker would receive \$2.28 per trip or 4.17 cents per mile. Reduced further, the trucker would receive 0.23 cents per pound of milk hauled per mile. The average time required to make this trip is 6.3 hours. At \$2.28 per trip the trucker would receive 36.19 cents per hour to pay for his labor, the cost of operating the truck, and the interest on his investment.

If the actual operation of each milk route were in a close degree of conformance with these average figures, there would be less cause for worry. Unfortunately, only 6.26 percent of the routes fall within this class. There are routes hauling less than 2,000 pounds per month at different times of the year, as seen in figure 1. Table 7 shows the number of routes hauling milk in classes of 10,000 pounds by months for 1941.

The large number of routes hauling less than 10,000 pounds during January, February, and March (figure 1) can be explained by the decrease in the number of patrons per route. With approximately

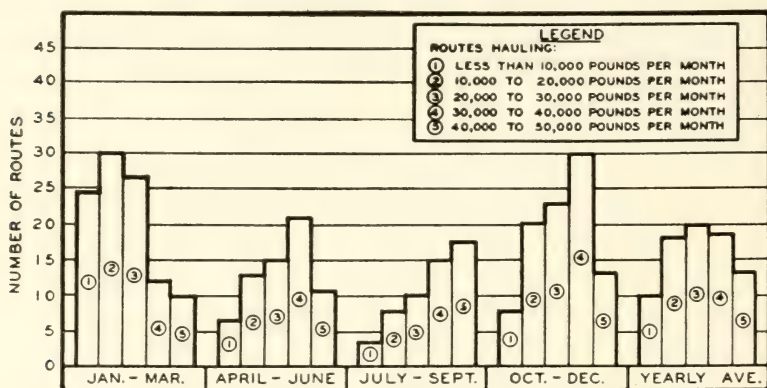


FIGURE 1
THE AVERAGE NUMBER OF ROUTES HAULING LESS THAN 50,000 POUNDS OF MILK PER MONTH, 1941.

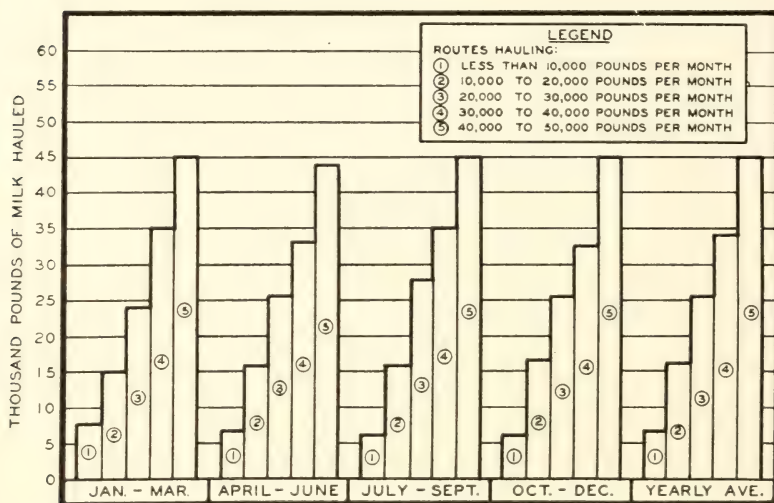


FIGURE 2
THE AVERAGE AMOUNT OF MILK HAULED PER MONTH BY ROUTES HAULING LESS THAN 50,000 POUNDS OF MILK PER MONTH, 1941.

50 percent fewer patrons on the routes at this time and milk production at approximately 50 percent less than the average monthly production, a large increase in low volume routes is unavoidable and expected. With the second and third quarters of the year having an increase in the production of milk and a corresponding increase in the number of patrons, the expected decrease in the number of low volume routes is attained. In the fourth quarter of the year the routes begin having a decrease in volume, thus increasing the number of low volume routes.

Table 7—The number of routes hauling less than 50,000 pounds of milk per month, 1941

Amount hauled per month	Number of routes hauling corresponding amount per month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Less than 10,000	17	30	26	7	6	5	3	4	3	8	7	9
10,000- 19,999	33	32	28	21	9	9	9	6	8	10	18	31
20,000- 29,999	31	25	24	24	12	10	8	6	16	19	28	32
30,000- 39,999	12	11	14	16	21	25	11	14	20	26	17	18
40,000- 49,999	10	11	9	13	9	12	14	18	18	12	14	13
Total	103	109	101	81	57	61	45	48	65	75	84	103

The noticeable decrease in the number of routes hauling less than 50,000 pounds per month was caused by an increase in milk production, and a corresponding increase in the volume of milk hauled by some of the routes. Routes hauling more than 50,000 pounds per month were not considered in this particular phase of the study, but are considered in the other parts of this report.

The amount of milk hauled per route per month varies directly with the amount of milk produced per month. Therefore, truckers hauling from areas of normally low production, or operating long routes with patrons producing a small amount of milk, are the ones that immediately become inefficient operators because of a low volume of business, and should be classed as marginal operators.

The average amount hauled during each quarter of the year for the routes classed in intervals of 10,000 pounds of milk hauled per month is shown in figure 2. Even though there is a change in the number of routes in these groups (figure 1) the average amount hauled by each group is approximately the same throughout the year. The low volume routes tend to have a decrease in the amount hauled, while the other groups fluctuate slightly to arrive at an even average for the year.

The variation by months in the amount of milk hauled is shown in table 8, giving the average amount hauled per route per month, and per route per trip. The variation in the amount of milk hauled per trip differs from the variation in the amount hauled per month because of the routes hauling milk twice a day from April to October, as seen in figure 3. From figure 3 it is evident that the increase in volume is not adequate to compensate for the increase in mileage during the period of two trips a day.

To adequately compensate truckers for the increased number of trips, the amount of milk hauled should be much greater. This directly decreases the efficiency with which the trucks operate from

a financial basis as seen in figures 4 and 5. It is normally expected that during the time of largest volume, the amount received per trip or per mile would be the highest, but this was not the case. Table 9 shows the dollars received per trip and the cents received per mile by these routes for each month. From this table it is apparent that the low volume routes do not have enough income to pay for the actual operation of the trucks. It is probable that many of the low volume routes are operated by milk producers who do not live very far from town and who haul for a few of their neighbors.

However, the prevalence of routes operating with such low vol-
Table 8—The average amount hauled per month per route and the amount hauled per trip per route for routes hauling less than 50,000 pounds per month

Month	Routes hauling from									
	0 to		10,000 to		20,000 to		30,000 to		40,000 to	
	9,999 lbs.		19,999 lbs.		29,999 lbs.		39,999 lbs.		49,999 lbs.	
	Cwt. hauled per month trip		Cwt. hauled per month trip		Cwt. hauled per month trip		Cwt. hauled per month trip		Cwt. hauled per month trip	
January	73	2.4	149	4.8	232	7.5	343	11.1	447	14.4
February	65	2.1	152	5.4	233	8.3	347	12.4	438	15.6
March	63	2.0	140	4.5	244	7.9	356	11.5	444	14.3
April	49	0.8	150	2.5	249	4.1	343	5.7	437	7.3
May	78	1.2	161	2.6	243	3.9	334	5.4	453	7.3
June	72	1.2	152	2.5	265	4.4	340	5.7	437	7.3
July	60	0.9	162	2.6	275	4.4	344	5.8	454	7.3
August	68	1.1	156	2.5	271	4.4	347	5.6	438	7.1
September	55	0.9	139	2.3	269	4.5	347	5.8	442	7.4
October	62	2.0	174	5.6	243	7.9	299	9.7	438	14.1
November	64	2.1	162	5.4	253	8.4	333	11.1	449	15.0
December	52	1.7	144	4.6	261	8.4	347	11.2	443	14.3
Average	63	1.5	153	3.9	253	6.2	340	8.4	443	10.9

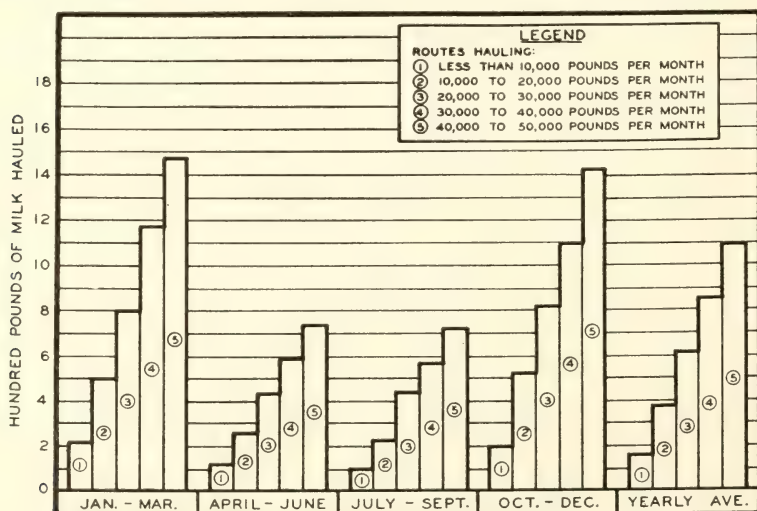


FIGURE 3.

THE AVERAGE AMOUNT OF MILK HAULED PER TRIP BY ROUTES HAULING LESS THAN 50,000 POUNDS OF MILK PER MONTH, 1941.

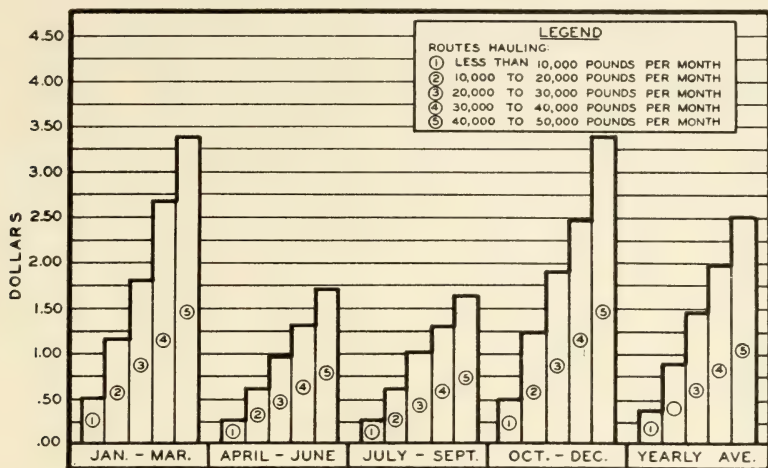


FIGURE 4.

THE AVERAGE NUMBER OF DOLLARS RECEIVED PER TRIP BY ROUTES HAULING LESS THAN 50,000 POUNDS OF MILK PER MONTH, 1941.

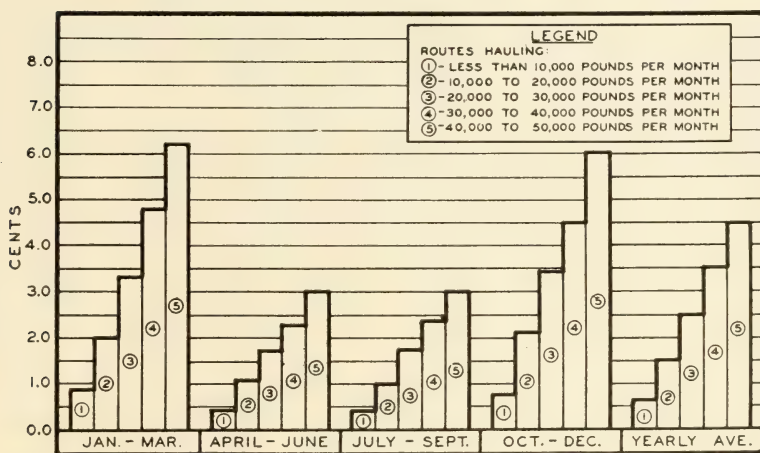


FIGURE 5.

THE AVERAGE NUMBER OF CENTS RECEIVED PER MILE BY ROUTES HAULING LESS THAN 50,000 POUNDS OF MILK PER MONTH, 1941.

ume is the reason that many of the milk plants resort to subsidization in order to keep some routes operating throughout the year so that the increased production in the spring and summer can be insured to the plants. The practice is undoubtedly costly and in all probability reduces the efficiency of the financial operation of the milk plants. Even the 4.57 cents average per mile return for the routes with 40 to 50 thousand pounds of milk per trip is hardly enough to adequately pay for the operation of the truck and leaves little, if anything, to pay for the time of the operator and the interest on the investment in the truck.

Table 9—Amount received per route per trip and amount received per route per mile for routes hauling less than 50,000 pounds per month

Routes hauling	0 to 9,999 lbs.		10,000 to 19,999 lbs.		20,000 to 29,999 lbs.		30,000 to 39,999 lbs.		40,000 to 49,999 lbs.	
	Amt. rec'd. per trip		Amt. rec'd. per trip		Amt. rec'd. per trip		Amt. rec'd. per trip		Amt. rec'd. per trip	
Month	dollars	cents	dollars	cents	dollars	cents	dollars	cents	dollars	cents
January	0.54	0.99	1.09	1.99	1.71	3.16	2.52	4.66	3.28	6.01
February	0.47	0.86	1.24	2.27	1.90	3.51	2.82	5.22	3.57	6.54
March	0.46	0.84	1.03	1.89	1.79	3.31	2.62	4.85	3.26	5.97
April	0.18	0.33	0.57	1.04	0.95	1.76	1.30	2.41	1.66	3.04
May	0.29	0.53	0.59	1.08	0.89	1.65	1.23	2.28	1.67	3.06
June	0.27	0.49	0.58	1.06	1.01	1.87	1.29	2.39	1.66	3.04
July	0.22	0.40	0.60	1.10	1.01	1.87	1.37	2.35	1.67	3.06
August	0.25	0.46	0.57	1.04	0.99	1.83	1.28	2.37	1.61	2.95
September	0.21	0.38	0.53	0.97	1.02	1.89	1.32	2.44	1.62	3.08
October	0.46	0.84	1.28	2.34	1.79	3.31	2.20	4.07	3.22	5.90
November	0.48	0.88	1.23	2.25	1.92	3.55	2.54	4.69	3.41	6.25
December	0.38	0.70	1.06	1.94	1.92	3.55	2.55	4.72	3.26	5.97
Average	0.35	0.64	0.86	1.58	1.41	2.60	1.91	3.54	2.49	4.57

Table 10—Monthly indices of amount of milk received at nine milk plants (1941)

Months	Total receipts ¹	Receipts from routes ²	Receipts from locals ³
January	45	48	25
February	44	45	37
March	54	55	48
April	84	87	66
May	134	141	79
June	123	123	122
July	153	153	152
August	162	132	204
September	133	132	204
October	118	104	227
November	82	90	24
December	68	67	80

¹Monthly average of total annual receipts=100²Monthly average of total annual receipts of routes=100³Locals are the patrons delivering their own milk and do not patronize the routes.

The fluctuation in monthly milk receipts is shown in table 10. Milk deliveries reach their lowest point in January and February and their highest point in July and August. It is difficult for the best routes to be operated efficiently during the low production period from November through March. Table 11 shows the monthly variation in the amount of milk hauled to the plants expressed as a percentage of the total for the year and the percentage increase of each month over the amount hauled the previous month.

Milk trucks operate once a day from October to April, and twice a day from April to October. In a few cases trucks operate every other day or three times a week during the months of January and February.

Table 11—Monthly variation in the amount of milk hauled to the milk plants

Month	Percent of amount hauled per year	Percent increase over previous month	Percent amount hauled for month is of previous month
January	4.01	-1.62	71.2
February	3.75	-0.26	93.5
March	4.41	0.66	117.5
April	7.19	2.78	163.2
May	11.77	4.58	163.7
June	10.31	-1.46	87.6
July	12.66	2.35	122.8
August	12.90	0.24	101.9
September	11.17	-1.73	86.6
October	8.41	-2.76	75.3
November	7.79	-0.62	92.6
December	5.63	-2.16	72.3

Only 7.19 percent of the amount of milk hauled for the year is hauled during April, which is 2.78 percent of the yearly receipts over that hauled in March, yet twice as many trips are made to haul this small increase in milk, resulting in a financial loss to the truck operators. During the month of October, milk is hauled only once a day and 8.41 percent of the total amount hauled for the year is hauled during this month. As shown in table 12, the average temperature for April is 63.6 degrees and for October it is 63.7 degrees, while the average maximum temperature is 75.6 degrees for April and 75.7 degrees for October. From a record of temperatures of the Agricultural Engineering Department for 33 years, it appears that October has had more than twice as many warm days as April. Table 12 shows the average temperature and the average maximum temperature for each month. If the temperature is the only factor involved in determining whether milk is to be collected once or twice per day in April, it would seem from these data that once-a-day hauling in April would get the milk to the plants in as good condition as it does in October.

Table 12—Average temperature for 33 years at State College, Mississippi¹

Month	Average temperature for month	Average maximum temperature for month
January	46.1	56.7
February	48.5	59.7
March	55.4	67.1
April	63.6	75.6
May	71.3	83.3
June	78.9	90.6
July	81.3	92.4
August	81.1	92.5
September	76.8	89.0
October	63.7	75.7
November	54.0	65.8
December	47.4	57.6

¹Data obtained from Department of Agricultural Engineering of Mississippi Experiment Station.

Relationships in Operations of Milk Routes

Little relationship exists between the number of hours required for a round trip to be made and the length of the route. The number of stops a truck must make on the route and the condition of the road over which the truck travels are much more important in determining the amount of time required for the trucks to make the trip.

By relating the number of hours required to make a trip to (1) the length of the route and (2) the volume of milk hauled, it was found that a marked degree of relationship existed. From this result an equation has been set up that can be used in determining the time required for a truck to make a trip. The equation is:

$$H = 3.1541 + 0.0458 M + 9.0087 V$$

H=number of hours required to make the trip

M=length of route (round trip)

V=pounds of milk expressed in terms of hundredweights.

For example, a trucker operating a 50-mile route and hauling 2,000 pounds of milk would require 5.6 hours to make the round trip.

$$H = 3.1541 + 0.0458 (50) + 0.0086 (20)$$

$$H = 5.6$$

Likewise, the number of miles in a trip can be determined if the time required and the volume hauled is known; or the volume of milk hauled can be determined if the time and the mileage are known. To determine the number of miles a route is in length, substitute the known quantities of time and volume in the following equation:

$$M = \frac{H - 0.0081 V - 3.1541}{0.0458}$$

To determine the volume of milk hauled, substitute the known quantities of time and miles in the following equation:

$$V = \frac{H - 0.0458 M - 3.1541 \times 100}{0.0087}$$

A similar equation has been set up to determine the amount of gasoline required for a truck traveling a known number of miles for a known number of hours:

$$G = 2.0771 + 0.0834 M + 0.0736 H$$

G=number of gallons of gasoline required

M=number of miles in a round trip

H=number of hours

For example, a trucker wants to know the number of gallons of gasoline required to make a 40-mile trip in four hours:

$$G = 2.0771 + 0.0834 (40) + 0.0376 (4)$$

$$G = 5.7$$

The results of these equations are approximations based on the actual operations of all trucks, and will only apply to average conditions. It is therefore not expected that these results would be accurate in every individual case, but are offered as guides in planning or organizing routes.

Truckers Penalized for Producers' Dirty Milk

One basis on which milk is refused by the plants is the amount of sediment in the milk. Plants run sediment tests every 2 weeks and oftentimes more frequently. There are four grades of sediments, numbers one, two, three, and four, with the sediment content being higher in numerical sequence of each group as seen in figure 6. These sediment pads were taken from actual sediment tests performed at a milk plant as part of their regular routine. Notice that the pads for number 4 are cut in half. This is the half of the pad kept by the plants, while the other half is returned to the producer so that he may actually see the sediment content of the milk.

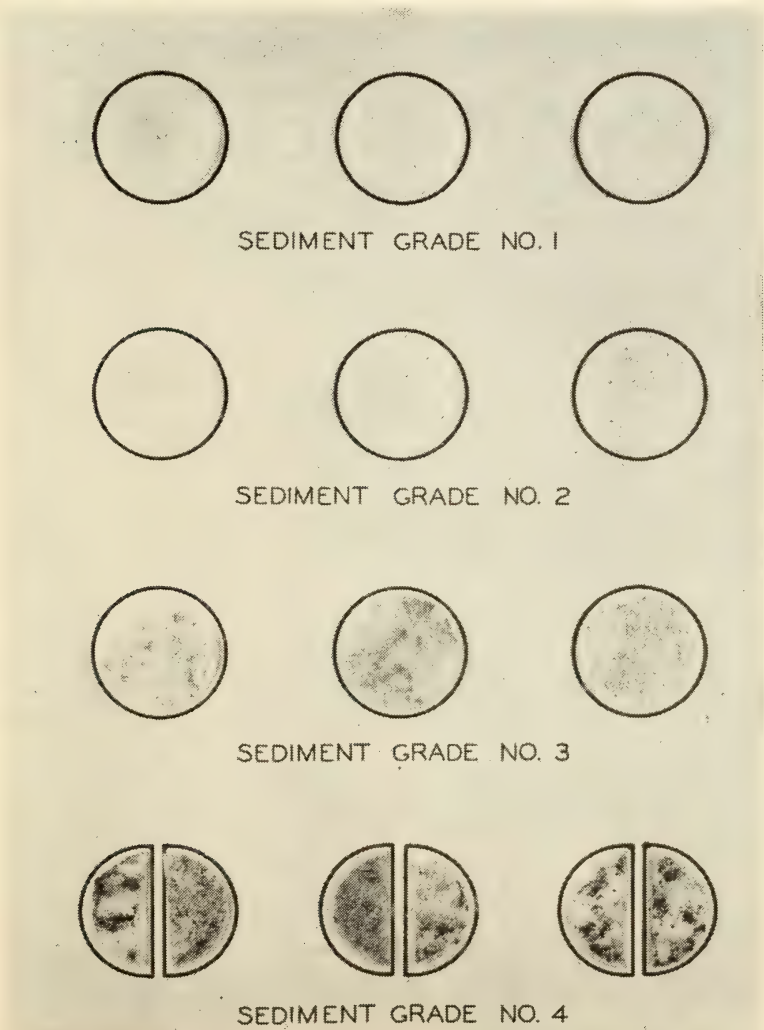


Figure 6. Pads obtained at milk plants from sediment tests performed at the plant.

Number four sediments are always rejected and oftentimes, number three, depending upon the discretion of the person taking sediment tests. Milk refused because of sediment tests is returned to the farmer with a tag showing the sediment pad and another tag giving instructions as to what changes the producer should make in order to produce clean milk.

The trucker unfortunate enough to have patrons on his route sending in dirty milk is required to return this milk to the farmer and at the same time, does not receive any pay for hauling this rejected milk. The trucker is only paid for hauling on the basis of the amount of milk weighed in at the plant. Since rejected milk is not weighed in at the plant, this weight is unknown and therefore the trucker is not paid for his labor and other costs of hauling this milk to the plant, or for returning it to the farmer. Therefore, the trucker is unjustly penalized for the laxness, carelessness, and indifference of some producers. In addition, the trucker may lose a patron from his route if the patron's milk is rejected and he has access to a route hauling to another plant.

Sediment reports for 1942 were obtained from three plants in three different counties. These plants purchased 5,388,475 pounds of milk from eight counties in Mississippi. The sediment reports revealed that 10.53 percent of the milk had a high sediment content of number four type, which amounted to 567,884 pounds of milk; 19.20 percent of the milk had a number three sediment, which amounted to 1,034,827 pounds of milk. Thus we have a breakdown within our dairy industry that is destructive and endangering to public health, to our war efforts, and to efforts to increase the efficiency of distribution by minimizing costs. Yet the only penalty assessed is the amount that the producer would have received in dollars and cents if the milk had been free enough of sediment to have been accepted. The penalty is not always that severe. Because of the fact that there is no legislative authority for coloring rejected milk with a harmless vegetable dye, patrons sometimes take this rejected milk and strain it through a filter strainer for resale. They are oftentimes able to sell this restrained milk through other channels. Thus, we have rejected milk resold for human consumption that has only had the physical sediment removed but still contains a live culture of bacteria increasing at a tremendous rate of speed.

Table 13 shows the average percentage of the four grades of sediments for all sediment tests taken by the plants in 1942. The 10.53 percent of milk rejected because of high sediment should arouse the interest of everyone concerned with the distribution of milk. Fortunately, from the view of financial loss to the truckers, sediment tests are not made daily. However, if they were, there is a possibility that producers would exert more effort to produce cleaner milk. If constant rejecting of milk with a high sediment test did not result in a decrease of rejectable milk, the charges for hauling milk would have to be increased in proportion to the amount of milk rejected.

The actual amount of milk in each sediment grade for the three plants is shown by months in table 14.

Table 13—Percentage of milk containing the four grades of sediments taken from three plants for 1942¹

Month	No. 1 accepted	No. 2 accepted	No. 3 possible rejection	No. 4 rejected
January	4.24	60.00	27.10	8.66
February	10.58	55.06	24.70	9.65
March	8.81	54.29	22.62	14.27
April	11.51	60.61	19.81	8.06
May	6.63	67.78	16.85	8.73
June	7.48	66.75	18.87	6.90
July	6.51	59.74	22.58	11.16
August	6.54	65.97	16.75	10.74
September	5.86	60.72	19.10	14.35
October	5.63	59.93	19.70	14.76
November	12.57	64.67	16.82	5.94
December	5.10	63.10	16.40	15.40
Average	7.27	63.00	19.20	10.53

¹Data obtained from 3 plants for 1942.

Table 14—Pounds of milk produced each month according to the percentage of the various sediment tests¹

Month	No. 1	No. 2	No. 3	No. 4	Total
January	7,042	99,645	45,006	14,382	166,075
February	17,101	88,998	39,925	15,598	161,639
March	18,194	112,120	46,715	29,471	206,521
April	43,471	228,914	74,819	30,441	377,683
May	18,955	193,784	48,174	24,959	285,901
June	49,754	443,992	125,515	45,896	665,156
July	48,260	442,869	167,392	82,732	741,328
August	103,414	1,043,157	264,861	169,827	1,581,260
September	26,638	276,022	86,825	65,233	454,582
October	20,175	214,760	70,595	52,893	358,351
November	31,359	161,336	41,962	14,819	249,476
December	7,164	88,640	23,038	21,633	140,475
Total	391,527	3,394,237	1,034,827	567,884	5,388,447

¹Data obtained from 3 plants for 1942.

Reports from plant managers and field men indicate that much work has been done by the field men and other plant representatives to aid the producer to send in clean milk. The plants are handicapped due to the fact that governmental control cooperating with the plants is not available. Therefore, the problem of plants rejecting unclean milk is purely a plant-patron relationship. There are no laws requiring rejected milk to be colored with a harmless vegetable dye to prevent producers from trying to sell the milk again. There are no inspections of dairy facilities on farms producing milk. Furthermore, there is no way in which a patron persistently producing dirty milk can be forced to produce clean milk for sale to the plants.

In addition to milk refused because of high sediment content, milk having excess acidity is also rejected, as well as milk having

off-flavors due to bitter weed and other causes. Likewise, the trucker returns this rejected milk without receiving a fee for hauling.

Possibilities of Reorganization of Milk Routes

Observing the map, as seen in figure 7, of the milk routes included in this study, a pattern of unorganized competition is brought to light. This pattern includes overlapping routes, routes having considerable mileage of back-tracking, routes poorly organized, and a few routes nonessential to the transportation of milk. At two points on the map, there are two plants located in the same community. There are instances of two trucks hauling milk over the same routes to separate plants within the same community. There are two plants in one community where the trucks operating the routes haul to both plants, giving a more efficient type of operation. The overlapping of trade areas for the plants included in this study makes a delineation of the areas very difficult.

Of the 119 routes on which information was obtained, 77 of these routes compete with 93 routes (table 15). This does not mean 93 routes are from plants included in this study, as only 57 of the 93 routes are from competing plants included in the study, while 36 routes are from plants not included in the study. In other words, many of the routes have more than one other route competing with it for the milk produced in the territory it serves. In addition to this amount of inter-plant competition (competition between plants), 14 routes of various plants reported intra-plant competition. By intra-plant competition is meant competition between routes hauling to the same plant. The number of routes at each plant competing with other routes is given in table 15.

From the information presented in this report, it seems that a reorganization of the trade areas of the plants would result in some reduction of the cost of transportation. At present, the entire milk marketing organization is operating on a basis far from any approach to minimum costs and maximum efficiency. These milk plants were not organized and set up all at one time, but have been developed with the expansion of the production of dairy cattle in this area. This fact must be kept in mind when consideration is given to the reorganization of milk routes and trade areas. Like the development of the dairy industry, done in steps as it was, the reorganization must also follow a similar pattern. There are numerous interests to be considered and the producers to be changed from one market to another, must be considered from the basis of their actual relationships to the efficiencies that are to be achieved.

The first step in the reorganization should be that of intra-plant problems; such a plan would be carried out through several phases.

First, action should be taken to enforce measures causing trucks operating within these supply areas to operate at full capacity during the seasons of higher production.

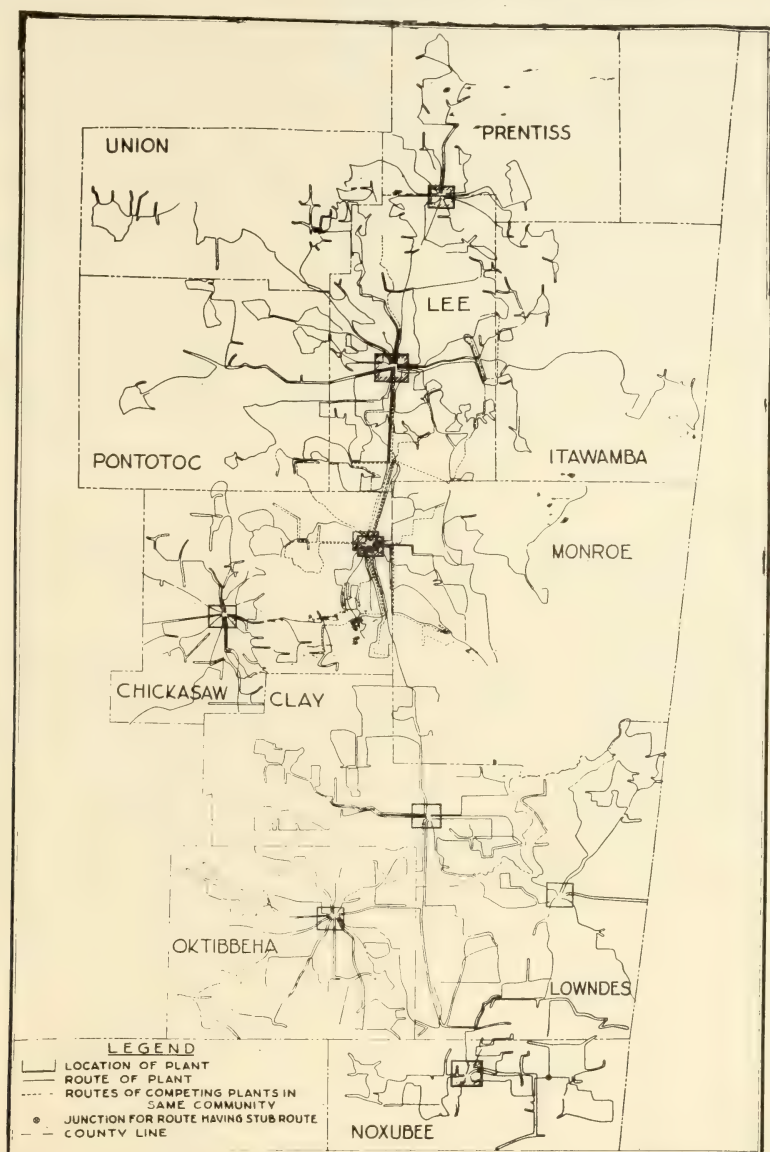


Figure 7. Routes of milk plants included in this study.

Second, during seasons of low production the pooling of loads should offer opportunities for additional savings.

Third, truckers going additional miles to haul an amount of milk for which hauling charges are not enough to equal the cost of operation, should require the producer to haul the milk to a loading point on the main route.

Fourth, where possible, there should be no routes competing with one another by traveling the same road.

These changes would affect the producer-hauler relationship and hauler-plant relationships, but producer-plant relationship would remain unchanged.

The second stage of reorganization would be based on the overlapping of trade areas of the various plants in order to eliminate inter-plant competition as much as possible. A reorganization plan of this type should be planned so that each plant would continue

Table 15—Competition of routes

Plant	Number of routes	Number routes reporting competitors from		Number plants to which competing routes haul milk	Number competing routes hauling to other plants
		Same plant	Others		
A	10	0	3	2	5
B	12	5	2	2	2
C	8	2	4	5	6
D	16	0	15	6	19
E	21	3	20	4	22
F	13	0	11	2	12
G	9	0	7	2	8
H	7	0	7	3	8
I	9	0	3	2	4
J	14	4	5	5	7

to receive the same quantity which it had received prior to any reorganization. This would necessitate the alteration of the supply areas of the various plants competing with one another.

This type of reorganization cannot be adequately and justly accomplished solely by a statistical and analytical procedure. Consideration must be given to the various patrons affected by any transitions between plants. It is recommended that a field problem procedure used in planning any suggested reorganization. The logical persons to engage in the evolution of workable plans are: (1) those having engaged in the actual research part of the study; (2) the plant managers and their field men; (3) the truck operators; (4) interested patrons; and (5) extension service workers. A committee for each area to be studied for reorganization should be selected from the personnel of the plants, truckers, and producers in each area. Actual records of milk receipts from each patron to be considered should be available to aid in determining the amount of milk to be lost and gained by the moving of patrons from one trade area to another.

It is from this part of the plan of reorganization that the reduction in the total number of trucks needed would reach the maximum. The reduction in the total number of miles traveled and the maximum savings in the mileage traveled would also be achieved.

The existing routes of one plant are shown in figure 8. It is evident from this map that some reorganization is possible. No attempt has been made to complete a plan of reorganization for the

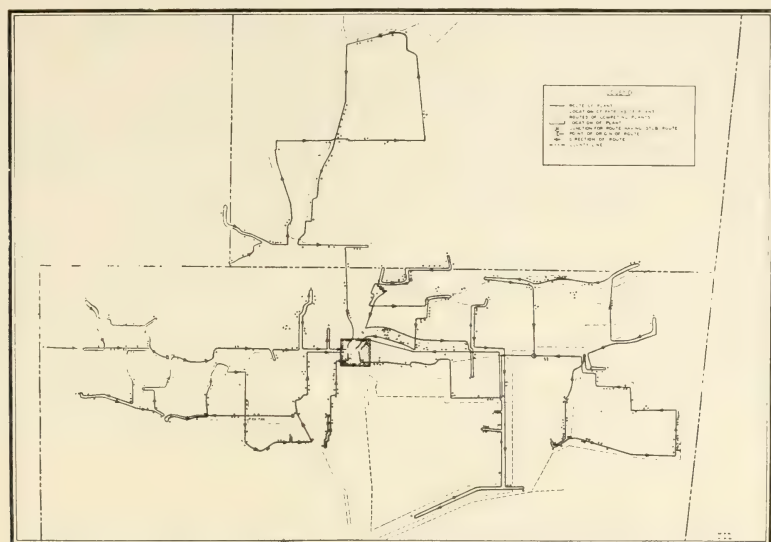


Figure 8. Routes of one plant showing location of patrons.

routes operating from this plant. As stated above, such a plan would include the cooperation of all plants competing with this plant. However, certain changes are suggested as a basis for reorganization.

Reorganization within the plant would be the first step. Before attempting to reorganize the routes, an inspection of the hauling schedules throughout the year should be made. The first step should be to consider the possibility of reducing the total number of trips per year made by each trucker. Table 16 gives the total amount of milk hauled per year for all routes, the total number of trips made and the total number of miles traveled.

Table 16—Amount of milk hauled, number of trips made and number of miles traveled for all routes hauling to one plant in 1942

Month	Total pounds of milk hauled	Total trips	Total miles traveled	Average amount hauled per trip
January	120,793	217	65,317	557
February	147,497	196	58,996	753
March	450,566	217	65,317	2,076
April	366,804	420	126,420	873
May	657,923	434	130,634	1,516
June	653,555	420	126,420	1,556
July	761,093	434	130,634	1,754
August	734,544	434	130,634	1,692
September	570,832	420	126,420	1,359
October	361,211	217	65,317	1,665
November	228,796	210	63,210	1,089
December	141,842	217	65,317	653
Total	5,195,456	3,836	1,154,636	1,354

From a discussion with plant managers and field men, the idea has been advanced that a reduction in the number of trips made annually could be based on one fact, that farmers produce clean milk and keep it sweet. Immediately the question arises as to the problems involved in keeping the milk from souring. Dairy specialists have successfully demonstrated the usefulness of placing the milk can in well water held at a low degree of temperature. There are numerous methods by which this can be accomplished with a minimum expense to the farmer. After adopting a satisfactory method of keeping the milk cool, truckers could reduce the number of trips made by approximately 55 percent. During the periods when milk is hauled once a day, the routes could operate every other day, and they could also reduce twice-a-day hauling to once-a-day hauling. Table 17 gives the amount of milk hauled per trip; the number of trips and the number of miles traveled for the same plant as in table 16 if this plan should be put into effect. The savings that could be made by such a plan are shown in table 18.

The second step in the reorganization of the routes of this plant would be to reduce the number of trucks being used by combining small routes with larger routes. Such a plan would release three trucks from the routes of this plant by: (1) combining 4 routes into 2 routes and (2) by eliminating a stub route, as seen in figure 9. This reorganization is presented with the reservation that this plan may be used as a basis on which the reorganization of the route can be established. To completely justify any such plan would require the actual data as to the production of each patron. As this study has not been carried to the point of obtaining such detailed information, the writer would not suggest the presented plan of reorganization as the final plan to be used. A further factor affecting the use of this plan is that of inter-plant competition, and this must be corrected on the basis previously stated in this bulletin.

Table 17—The number of trips made by all routes, the average amount of milk hauled per trip, and the number of miles traveled under the presented plan of schedule reorganization¹

Month	Total pounds of milk hauled	Total trips	Total miles traveled	Average amount hauled per trip
January	120,793	112	33,712	1,078
February	147,497	98	29,498	1,505
March	450,566	112	33,712	4,023
April	366,804	105	31,605	3,493
May	657,923	112	33,712	5,874
June	653,555	210	63,210	3,112
July	761,093	217	65,317	3,507
August	734,544	217	65,317	3,385
September	570,832	210	63,210	2,716
October	361,211	112	33,712	3,225
November	228,796	105	31,605	2,179
December	141,842	112	33,712	1,266
Total	5,195,456	1,722	518,322	35,363

¹Based on data from table 16.

find it advantageous to subsidize certain low volume routes during periods of low production.

The major problems in getting milk hauled to the plants are lack of tires, low volume routes, bad roads, and inadequate personnel to perform these duties.

Approximately 90 percent of the milk sold to milk plants in the area is hauled by truckers, with 10 percent of the milk being delivered by patrons hauling their own milk.

Forty-six percent of the patrons live on dirt roads, most of these roads being very difficult to travel in wet weather.

Eighty-nine percent of the truckers haul milk produced on their own farms as well as hauling for producer patrons. These trucks also serve to transport other farm commodities to market, and to haul farm supplies from local trading centers back to the farms.

Sixty percent of the trucks are of 1½-ton capacity. Forty percent of the trucks hauling milk had been on the route 6 months or less.

Fifteen percent of the trucks which haul over 6,000,000 pounds of milk a year were reported in poor mechanical condition, with 50 percent of these having traveled over a hundred thousand miles.

Trucks average traveling 2,183 miles per month. Truckers are having difficulties in keeping their trucks equipped with tires, and are experiencing poor results with recapped tires. Milk routes operated with a pick-up truck have much more difficulty in securing tires because of classification of pick-ups with passenger cars.

The average length of a milk route on a round trip basis is 54.6 miles with the average price paid for hauling being 22.8 cents per hundredweight. The average amount received per mile by milk trucks is 4.17 cents, averaging 36.19 cents per hour. The average number of hours required to make a trip is 6.3.

Truckers are not paid for hauling milk rejected because of sediment content, but return this rejected milk to the farmer free of charge. Approximately 10.53 percent of the milk delivered is rejected due to sediment content.

Milk is also rejected on the basis of excess acidity, and the trucker hauls this rejected milk free of charge.

Sixty-five percent of the milk routes have competition with routes hauling to other plants—one percent of the routes compete with themselves by hauling to the same plants.

Trucks haul milk twice daily from April to October and once a day from October to April. The increased volume during the period of twice-a-day hauling is not enough to compensate for the increase of twice the amount of mileage. Possibilities of changing twice-a-day hauling to once-a-day hauling and once-a-day hauling to every

other day hauling offer considerable opportunity to make savings in the mileage required for the assembling of milk.

Conclusions

The present system by which milk is hauled from farms to plants has been established on a basis of competition between milk plants with overlapping production areas. The result is an inefficient operation of milk routes. Competition, rather than efficient planning, has developed an extensive system of milk routes instead of an intensive system.

Milk truck operators are an essential part of each community not only for the hauling of milk, but also for the numerous services they perform. However, there are some operators who should withdraw from the hauling of milk as they are not operating on a profit or on a break-even basis. The inefficiencies with which some of the routes operate indicate that the income from these routes is insufficient to attract truckers of the type that would make trucking their main source of income. Consequently, only truckers doing part-time trucking have been attracted to this work.

The production of milk in general needs to be increased throughout the year. Even though the amount of milk hauled from April through September is much greater than that hauled from October through March, the increase in volume is not adequate to warrant the increased mileage of hauling milk twice a day.

The system on which hauling charges are based does not indicate that it has been established on any economic principles but rather on conventions set by precedents. Charges are based on a flat rate per hundredweight with very little attention given to the distance the milk is hauled. Therefore, the farmer living closer to the milk plant is subsidizing the farmer living farther away.

Extreme care must be exercised by truckers in conserving trucks and tires in every possible way, as the present inventory of milk trucks and tires shows that the average condition of these facilities is not the best and that much is expected of their use.

Truckers are operating milk routes at an income per mile below the usual 5 cent rate at which commercial cars operate, yet the trucks are subjected to much more strenuous use and over roads that offer difficulties in traveling during wet weather.

The income derived from hauling feeds and other miscellaneous articles could not be ascertained. However, this is not income from hauling milk, but is additional income with no extra cost of operation and may or may not be used in reflecting the profits and losses incurred in the milk hauling operations.

The present practice of truckers hauling rejected milk free of charge from farms to plants and back to farms should be abolished.

This is a costly operation and in no way serves to discourage patrons from producing dirty milk.

The trade areas are not organized on a basis from which the cost of transportation can be reduced to a minimum. Reorganization within the areas served by each plant as well as adjustments of the trade areas between the plants offers considerable opportunity to make savings in the miles traveled and in the conservation of the physical facilities for hauling milk.

A reduction in the number of trips made per year would effect an important saving and would also increase the efficiency with which the trucks operate.

Recommendations

From the data obtained and the facts found in this research study pertaining to the problems of the transportation of milk from farms to plants, it is believed that some of these problems could be alleviated by the adoption of new practices or by the revision of practices now being employed. These changes would include those to be made by (1) farmers, (2) plants, (3) truckers, and (4) governmental agencies.

Cooperation by Farmers

Since the point of origin for milk routes is the farm, certain suggestions are made that can be put into practice by farmers to aid in conserving trucks, tires, time, and operating expense in hauling milk from farms to plants.

1. Farmers should know what time truckers come for the milk and should have it ready to go at that time. Truckers should not have to wait for the milk, as the rest of the patrons on the routes should be considered.

2. Farmers living on bad roads of an impassable type during wet weather should haul their milk to the main road and should not expect the trucker to travel over these roads at such times.

3. Farmers should not expect the truckers to drive extra mileage for an amount of milk too small to pay for the cost of hauling. Truckers should be allowed a legitimate profit.

4. Any possible increase in the production of milk by improved practices of both feeding and husbandry should be made. Consideration should also be given to the possibility of increasing the size of the dairy herds where it is economically feasible.

5. Farmers should investigate and consider methods for holding milk at a required minimum temperature to aid in decreasing the number of trips made for hauling milk to the plants.

Cooperation by Plants

Certain revisions and reorganization of milk routes by plants to increase the density of milk hauled per mile is of great necessity. Plants should give every consideration to such reorganization of routes for the most efficient operations. The following recommendations are set up for their consideration:

1. Plants should cooperate with each other through their joint association to reorganize overlapping routes in order to eliminate as much duplication as possible and at the same time to provide approximately the same volume of milk for all plants as they are now receiving.

2. Plants should eliminate the practice of more than one truck hauling over the same route if the volume of milk hauled is not ample for two trucks.

3. Wherever two plants in the same community are receiving milk from the same area, the milk from each route should be hauled by one truck as long as the volume of milk hauled does not require two trucks. An excellent example of this feature is found in Ok-tibbeha County.

4. A survey should be made to determine the possibilities of setting up a series of zones by mileage or some other geographical distinction on which the charges for hauling milk could be more scientifically computed. This type of reorganization should be in the direction of increasing the intensity of milk production nearer the plants.

5. The possibility of organizing routes to reduce the total number of trips should be examined and every possible effort should be made to carry out such a program.

Cooperation by Truckers

The truckers also need to change some of their practices to increase the conservation of their trucking facilities and also to render their operation more efficient from a financial standpoint.

1. Truckers should exercise every possible precaution to conserve their trucks and tires.

2. Speed regulations apply to milk trucks just as they do to passenger cars. Owners of trucks employing drivers should take particular precautions to determine if the drivers are observant of such regulations.

3. Truckers should cooperate with plants to force producers living on bad roads to haul their milk out to the main roads, and furthermore, truckers should refuse to travel extra mileage for a small quantity of milk that makes travel more costly than the amount of milk hauled.

4. The practice of allowing riders atop milk cans is particularly questionable, and from many standpoints, undesirable. It is recommended that such practice be curtailed as much as possible.

Cooperation Between Truckers and Rationing Board

The numerous problems of local rationing boards are increasing daily and becoming more burdensome. However, it is recommended that these boards keep in mind the absolute necessity of getting milk to the plants without delay, and that, if possible, a milk truck should be able to secure a permit for a tire when an emergency arises with less delay than is ordinarily required. Likewise, it is recommended that the truckers keep in mind the recommendations issued by local rationing boards, which are:

1. Do not overload tires at any time.
2. Have tires retreaded at the proper time; otherwise tires will be confiscated.
3. Haul as much farm produce to and from market as possible, but do not overload tires.
4. Haul passengers and other commodities with milk, but do not overload tires.
5. Use good common sense in taking care of the tires.

Cooperation by Government

1. Appropriate legislation should be enacted and ample funds appropriated for its enforcement to require:

- (1) The refusal of milk because of excessive sediment, acidity, off-flavors, or other reasons.
- (2) The addition of a harmless vegetable dye to rejected milk so as to prevent further attempts to sell this milk.
- (3) Periodical official inspection of all farms producing milk for sale to milk plants.

2. Truckers should not be allowed to haul rejected milk free of charge. A set fee should be charged for hauling this milk, preferably at a higher rate than that normally charged for hauling acceptable milk.

3. Truckers should have their trucks covered or enclosed so as to prevent dirt and other foreign matter from accumulating on the cans.

The Relation of Feed of the Dairy Cow To Production

By

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The Relation of Feed of the Dairy Cow to Production

By J. S. MOORE and W. C. COWSERT

The primary aim of the dairyman in the utilization of the dairy cow is to obtain the greatest profit, direct and indirect, throughout her life on the farm. Since from 50 to 60 percent of the total cost of milk production is incurred in the feed consumed, the efficiency and success of the dairy farmer will depend quite largely on his ability as a feeder.

It is claimed that 90 percent of all the dairy cows in the State of Mississippi are either underfed or are not fed economically. Among the reasons for this are lack of suitable feed grown on the farm, the high price of purchased feeds, and the lack of sufficient variety of feeds which contain all the necessary nutrients in the right proportion. To feed efficiently, it is not only necessary to provide feed for the immediate production of milk, but also to maintain the health and vigor of the animal so that she may continue high production year after year throughout her normal productive life.

Mississippi has many advantages as a dairy state and dairying fits in well with the much needed diversified farm program, but improved practices in selection, breeding, feeding, and management are essential to attainment of the most profitable results.

Recognizing the major importance of additional information in regard to the relation of feed to production, this Station entered into a cooperative agreement with the Department of Agriculture and nine other experiment stations in a study of this problem. Work begun here January 1, 1937 and continuing for 4 years, had for its objectives: (1) to determine the relationship between rate and method of feeding and milk production of dairy cows; (2) to obtain information that will permit the determination of the most economical rate of feeding under various price conditions; and (2) to apply the principle of increasing and diminishing returns to milk production.

A technical bulletin has been issued by the Department of Agriculture giving the combined report of all the cooperating groups, but a popular bulletin covering a report of the work of the Mississippi Station should be helpful to the dairymen in this section.

There are several feeding standards that may be used as guides in feeding dairy cows. These standards attempt to give, under average conditions, the amount and kind of feed needed for animals of different sizes and milk production capacities. Rations based on these standards may or may not be the most profitable. Some of the questions not answered by these standards are: What would be the results if the ration were cut down below the standard; How far above the standard may the cow be fed with profit; How efficiently does the cow use the feed for production when fed below or above the standard.

In our investigations, we have assumed that the maintenance requirements of the animals as accepted in most of the leading feeding standards are approximately correct, and therefore we need only to determine the influence of that part of the feed available for production.

Plan of Test

In planning this test—which is concerned primarily with the kinds, quantities, and costs of feed—the rations were prepared with a view of supplying sufficient amounts of protein, minerals, and vitamins to meet the requirements of the animals in each group. This was done so that any change of production might be attributed to the quantity fed or method of feeding rather than to a deficiency of any particular constituent.

For ease in comparing one group with another, all of the milk was converted to milk averaging 4 percent butterfat. This was accomplished by the use of the following generally accepted formula:

Pounds of 4 percent milk equals 0.4 times the pounds of milk produced plus 15 times the pounds of fat produced.

Illustration: Let us assume that a cow gives 5250 pounds of milk testing 5.25 percent fat and containing 275.62 pounds of fat. According to the rule, we multiply 5250 by 0.4 and add 275.62 multiplied by 15. The result is 6234 pounds of 4 percent milk.

When the experiment was started, 20 cows were selected. These were divided into four equal groups of five cows each. These groups were fed at four different feeding levels. The allowance of total digestible nutrients or maintenance of all of the groups was the amount specified by the Haecker Standard. The amount of digestible nutrients for the production of milk varied with the different groups as follows:

- Group 1: 85 percent of Haecker Standard
- Group 2: 100 percent of Haecker Standard
- Group 3: 115 percent of Haecker Standard
- Group 4: 130 percent of Haecker Standard

This group of cows was fed 85 percent of Haecker Standard.



Table 1. Quantities, costs, and total digestible nutrients at four feeding levels consumed by cows during first year of experiment: 1937

Group	Feeding level	No. of cows	Feed consumed and nutrient content										Value of feed eaten				Cost of 100 lbs. T.D.N.	
			Lespedeza hay		Sorghum silage		Concentrates		Yearly T.D.N. intake lbs.	Hay \$10.00 per ton	Silage \$3.50 per ton	Concen- trates \$30.00 per ton	Total cost of feed dol.					
			Con- sumed lbs.	T.D.N. lbs.	Con- sumed lbs.	T.D.N. lbs.	Con- sumed lbs.	T.D.N. lbs.										
1 per cow	85%	5	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	dol.	dol.	dol.	dol.	dol.		
			4551	4642	3218	1670	9754	1380	2093	1593	4642	16.09	17.07	31.39	64.55	1.391		
			4658	4793	3340	1742	8976	1292	2319	1759	4793	16.70	15.71	34.78	67.19	1.402		
			4523	4551	3071	1602	7964	1147	2375	1802	4551	15.36	13.94	35.62	64.92	1.426		
			3800	3759	3075	1580	7973	1194	1334	984	3759	15.33	15.70	20.01	51.04	1.358		
			4331	4360	3307	1732	9735	1321	1790	1337	4360	16.54	17.03	26.85	60.42	1.386		
Av.			4371	4421	3202	1659	9080	1267	1982	1495	4421	16.01	15.89	29.73	61.63	1.394		
2 per cow	100%	5	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	dol.	dol.	dol.	dol.	dol.		
			3541	3678	2834	1486	8016	1132	1425	1060	3678	14.32	14.03	21.37	49.73	1.352		
			4150	4244	2811	1456	7876	1107	2209	1681	4244	14.06	13.78	33.13	60.97	1.436		
			4785	4943	3090	1606	9094	1295	2687	2042	4943	15.45	15.91	40.30	71.66	1.450		
			4418	4571	3362	1748	9489	1353	1934	1470	4571	16.81	16.61	29.01	62.43	1.366		
			3842	3824	2882	1484	8276	1039	1866	1301	3824	14.41	14.48	27.99	56.88	1.487		
Av.			4151	4252	3002	1556	8559	1185	2024	1511	4252	15.01	14.96	30.36	60.33	1.419		
3 per cow	115%	5	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	dol.	dol.	dol.	dol.	dol.		
			5512	5694	3315	1728	8733	1254	3571	2712	5694	16.58	15.28	53.56	85.42	1.500		
			4621	4775	3034	1577	8688	1236	2582	1962	4775	15.17	15.20	33.73	69.10	1.477		
			4707	4783	3065	1592	8971	1269	2527	1923	4783	15.33	15.70	37.90	68.93	1.441		
			5768	5943	3195	1662	9400	1338	3871	2943	5943	15.98	16.45	58.06	90.49	1.619		
			5379	5445	2974	1542	8436	1191	3564	2712	5445	14.87	14.76	53.46	83.09	1.526		
Av.			5197	5328	3117	1620	8846	1258	3223	2451	5328	15.58	15.48	48.34	79.40	1.490		
4 per cow	130%	6	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	dol.	dol.	dol.	dol.	dol.		
			5625	5713	2858	1487	7393	1055	4174	3171	5713	14.29	12.94	62.61	89.84	1.573		
			6534	6539	3188	1654	8651	1226	4808	3659	6539	15.94	15.14	72.12	103.20	1.578		
			6923	6976	2921	1517	7991	1132	5687	4327	6976	14.60	13.98	85.30	113.88	1.632		
			5946	5885	3087	1582	9076	1152	4360	3151	5885	15.43	15.83	65.40	96.66	1.642		
			7080	7106	3372	1753	9151	1298	5343	4055	7106	16.86	16.01	80.14	113.01	1.593		
Av.			5805	5892	3205	1662	9727	1234	4325	2996	5892	16.02	17.02	64.87	97.91	1.660		
Av.			6319	6352	3105	1609	8665	1183	4793	3560	6352	15.52	15.16	71.74	102.42	1.612		

*T.D.N.—total digestible nutrients.

Table 2. Effect of feed at four feeding levels on live weight, milk production, and profits during first year of experiment: 1937

Group	Feeding level	No. of cows	Milk production			T.D.N. eaten		Live weight		Ratio of 4% concentrates to 4% milk 1 to	Value of milk @ \$1.60 per 100 lbs.	Value of feeds	Value of milk over cost of feed	Cost of feed for 100 lbs. milk
			Expect- ed 4% milk	Age	Days in milk	Produc- ed 4% milk	Percent of ex- pected yield	For main- tenance	For produc- tion	Begin- ning	Close	Gain or loss		
			lbs.	yrs. mos.		lbs.	percent	lbs.	lbs.	lbs.	lbs.	lbs.	dol.	dol.
1	85%	5	7523	7 - 5	306	6723	89.3	2583	2059	917	837	- 80	64.55	960
			7268	7 - 2	303	7417	101.8	2498	2295	1000	890	-110	67.19	906
			6457	5 - 7	302	7631	118.2	2299	2252	908	790	-118	64.92	851
			7821	7 - 1	321	4730	60.5	2417	1342	892	778	-114	51.04	1079
			6379	8 - 6	308	5732	89.8	2667	1693	933	898	- 35	60.42	1054
Av. per cow			7090	7 - 2	308	6447	90.9	2493	1928	930	839	- 91	61.63	956
2	100%	5	5807	4 - 6	302	4012	69.1	2156	1522	713	712	- 1	49.72	1239
			6583	3 - 10	319	5839	88.7	2128	2116	778	760	- 18	60.97	1044
			5754	7 - 3	320	7006	121.7	2388	2555	920	842	- 78	71.66	1023
			5183	4 - 11	302	5274	101.8	2628	1943	1015	867	-148	62.43	1182
			6661	4 - 0	241	4891	73.4	2175	1650	740	750	10	56.88	1163
Av. per cow			5998	4 - 11	297	5404	90.1	2295	1957	833	786	- 47	60.33	1116
3	115%	5	6636	4 - 7	302	7844	118.2	2395	3299	920	847	- 73	85.42	1089
			5676	12 - 2	319	5857	103.2	2309	2466	925	760	-165	93.71	1180
			7118	4 - 7	330	5842	82.1	2402	2381	803	862	59	93.47	1180
			8430	6 - 4	322	8251	97.9	2499	3444	940	908	- 32	132.02	1097
			4445	6 - 4	298	7938	178.6	2267	3183	757	745	- 12	127.01	1047
Av. per cow			6461	6 - 10	314	7146	110.6	2374	2954	869	824	- 45	114.34	1111
4	130%	6	4395	5 - 1	302	8104	184.4	2005	3708	800	675	-125	129.66	1109
			5672	4 - 4	326	8791	155.0	2575	3964	863	952	89	140.66	1174
			6198	8 - 7	313	10232	165.1	2349	4627	915	845	- 70	163.71	1113
			5636	9 - 1	319	7869	139.6	2433	3452	902	860	- 42	125.90	1228
			6126	5 - 2	302	9680	158.0	2796	4310	1060	1007	- 53	154.88	1167
Av. per cow			9788	4 - 3	302	7515	76.8	2432	3460	860	900	40	120.24	1290
			6302	6 - 1	311	8698	138.0	2432	3920	900	873	- 27	139.17	1178

The difference in the rate of feeding was accomplished in the main by varying the amounts of concentrates. The experiment lasted through two full lactation periods without change of the general plan, except in a few cases where it was necessary to substitute a comparable cow of like qualifications or in the second year to reduce the number of cows in a given group. The ration of each cow was adjusted each week, based on production during the preceding week.

The expected production, as shown in the tables, was based on production during one or more preceding lactation periods. No cows, therefore, were selected that did not have at least one full lactation period. The cows were weighed for 3 consecutive days each month. The milk of each cow was weighed and recorded at each milking. Tests of the milk for butterfat were made every 2 weeks, using 2 days composite samples. The cows were fed individually, the feed given each cow being based on the production of the preceding week.

Feeds used in Test

Chemical analyses were made of all feeds used, and the coefficients of digestion used in determining the digestible nutrients were those published in Morrison's **Feeds and Feeding**, 20th Edition. The hay consisted principally of No. 2 lespedeza and Nos. 1 and 2 Johnson grass. The silage was good quality sorghum silage. The concentrates from the beginning to September 14, 1937 consisted of:

	Pounds		Pounds
Crushed oats	70	Soybean meal	140
Wheat bran	140	Blackstrap molasses	70
Cottonseed meal	266	Oystershell flour	7
Crushed ear corn	300	Salt	7

Due to the fact that some of these feeds were not obtainable after that date, the feed after September 14, 1937 consisted of:

	Pounds
Crushed oats	100
Wheat bran	200
Cottonseed meal	300
Crushed ear corn	300
Blackstrap molasses	80
Oystershell flour	10
Salt	10

This concentrate mixture was fed for the rest of the experiment.

Cows were not allowed to run on pasture during the first three lactation periods. This applies to the months the cows were dry as well as when in milk production.

In order to make the results comparable, the same values of the feeds and milk were used during the entire experiment. The values were:

Feed	Per ton	Production—Per 100 pounds 4 percent milk
Hay	\$10.00	\$1.60
Silage	3.50	
Concentrates	30.00	

Tables are given later in the bulletin to explain how these prices may be varied to allow the dairyman to determine the most economical ration to use, based on the prevailing relative prices of feeds and milk.

Table 3. Quantities, costs, and total digestible nutrients at four feeding levels consumed by cows during second year of experiment: 1938

Group	Feeding level	N ^o . of cows	Feed required and nutrient content						Yearly T.D.N. intake	Value of feed eaten			Total cost of feed	Cost of 100 lbs. T.D.N.	
			Lespedeza hay		Sorghum silage		Concentrates			Hay \$10.00 per ton	Silage \$3.50 per ton	Concentrates \$30.00 per ton			
			T.D.N. required	Consumed	T.D.N.	Consumed	T.D.N.	Consumed							
			lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	dol.	dol.	dol.	dol.	dol.	
1 027 513 013 Av. per cow	85 %	3													
				3059	1580	9304	1187	1058	777	3544	15.29	16.28	15.87	47.44	1.339
				3068	1573	9194	1151	511	361	3085	15.34	16.09	7.66	39.09	1.267
				3189	1672	9660	1309	889	614	3595	15.94	16.90	13.33	46.17	1.285
				3105	1608	9386	1216	819	584	3408	15.52	16.42	12.28	44.22	1.298
2 637 662 517 Av. per cow	100 %	3													
				2725	1422	7958	1025	919	633	3080	13.62	13.93	13.78	41.33	1.342
				2804	1448	8128	1024	1517	1050	3522	14.02	14.22	22.75	50.99	1.448
				2745	1415	7868	990	1010	707	3112	13.72	13.77	15.15	42.64	1.370
				2758	1428	7985	1013	1149	797	3238	13.79	13.97	17.23	44.99	1.389
3 072 075 601 553 Av. per cow	115 %	4													
				2973	1524	8853	1105	2037	1428	4057	14.86	15.49	30.55	60.90	1.501
				2996	1543	8998	1132	2017	1407	4082	14.98	15.75	30.25	60.98	1.494
				3123	1603	9566	1194	3056	2139	4936	15.61	16.74	45.84	78.19	1.584
				2882	1506	8449	1133	3986	2762	5401	14.41	14.78	59.79	88.98	1.648
			4655	2993	1544	8966	1141	2774	1934	4619	14.96	15.59	41.61	72.26	1.564
4 692 600 L1 Av. per cow	130 %	3													
				2982	1565	9243	1324	3818	2615	5504	14.91	16.17	57.27	88.35	1.606
				3319	1707	10139	1272	4855	3388	6367	16.59	17.74	72.82	107.15	1.683
				2928	1511	8805	1107	5000	3469	6087	14.64	15.41	75.00	105.05	1.726
				3076	1594	9396	1234	4558	3158	5986	15.38	16.44	68.37	100.19	1.674

First Lactation Period

At the end of the first year several results were clearly evident. Tables 1 and 2 show that group 1, fed 85 percent, and group 2, fed 100 percent of Haecker Standard, averaged less than the expected yield. The average expected yield was 6544 pounds of 4 percent milk, while the actual yield was 5925 pounds milk or 90.5 percent of the expected. Group 3, fed 115 percent of Haecker Standard, produced 7146 pounds or 110.6 percent of expected yield. Group 4, fed 130 percent of Standard, produced 8698 pounds or 138 percent of expected yield.

All of the groups lost in weight; in group 1 the average loss in weight per cow was 91 pounds; in group 2, 47 pounds; in group 3, 45 pounds, and in group 4, 27 pounds.

The cost of 100 pounds of total digestible nutrients and the feed cost of 100 pounds of milk were least with the group receiving the 85 percent Standard, being \$1.394 for total digestible nutrients and \$0.96 for 100 pounds of milk. These costs increased with each group until group 4, receiving 130 percent of Standard, cost \$1.612 for total digestible nutrients and the feed cost of 100 pounds of milk was \$1.178. Roughage furnished the following percent of total digestible nutrients in the feed: Group 1, 66.2 percent; group 2, 64.5 percent; group 3, 54.0 percent; and group 4, 44.0 percent.

This group of cows was fed 130 percent of Haecker Standard.



This group of cows was fed 175 percent of Haecker Standard.



Second Lactation Period

Tables 3 and 4 give the results of the second lactation period.

For various reasons it was not possible to continue all five cows in each group through the second lactation period. Some failed to breed, others aborted, and other causes reduced the number to three, except there were four completing the test in group 3.

In comparing the record of the cows during the second lactation with the first, it is noted that the production especially in groups 1 and 2 is much lower than during the first year. The percentages of expected production realized were: for group 1, 46.5; for group 2, 55.7; for group 3, 74.3; and for group 4, 108.8. The average production of groups 1 and 2 was only 50.9 percent of the expected yield, while during the first lactation period, they produced 90.5 percent of the expected yield. This was probably due to the first year loss in flesh and the lack of vigor to carry on. At the end of the second year the cows in group 1 had to be dropped from the experiment. During the two lactation periods they had lost in live weight an average per cow of 179 pounds.

Groups 1, 2, and 4 lost approximately the same live weight per cow as during the first year, but group 3 gained an average of 8 pounds. Due to reduced yields the second year the feed cost per 100 pounds of milk increased, the amount for the different groups being: group 1, \$1.37; group 2, \$1.30; group 3, \$1.20; and group 4, \$1.26. The value of the milk per cow over cost of feed was: Group 1, \$7.51; group 2, \$10.22; group 3, \$23.71; and group 4, \$26.97.

Table 5. Quantities, costs, and total digestible nutrients at five feeding levels consumed by cows during third year of experiment: 1939

Group	Feeding level	No. of cows	Feed required and nutrient content				Concentrates		Yearly T.D.N. intake	Value of feed eaten		Total cost of feed	Cost of 100 lbs. T.D.N.
			Lespedeza hay		Sorghum silage		Con- sumed	f.D.N.		Hay \$10.00 per ton	Silage \$3.50 per ton		
			Con- sumed	T.D.N.	Con- sumed	T.D.N.						lbs.	lbs.
2 558 728 043 563 Av. per cow	100%	4	2738	2797	7691	1144	449	308	2879	13.69	13.46	33.88	1.177
			2968	3747	8482	1267	1418	972	3785	14.84	14.84	50.95	1.346
			3282	4213	10031	1478	1726	1183	4364	16.41	17.56	59.86	1.372
			3271	4893	10037	1478	2464	1688	4863	16.36	17.56	70.88	1.457
			3065	3912	9060	1342	1514	1038	3973	15.33	15.85	53.89	1.356
3 632 517 619 Av. per cow	115%	3	2800	3590	8073	1186	1474	1010	3665	14.00	14.12	50.23	1.452
			1968	3292	5580	818	2007	1375	3229	9.84	9.78	49.72	1.540
			3631	5208	9619	1452	2315	1928	5256	18.16	16.83	77.22	1.469
			2800	4030	7757	1152	2099	1438	4050	14.00	13.58	59.06	1.458
4 072 075 601 514 Av. per cow	130%	4	3030	5054	6967	1331	3146	2155	5068	15.15	15.69	78.93	1.540
			3481	5146	7556	1138	3219	2205	5142	17.41	13.22	78.91	1.532
			3256	4849	10314	1493	2485	1702	4913	16.28	18.05	71.31	1.457
			3432	5952	10535	1565	3769	2582	5939	17.16	18.44	92.14	1.551
			3300	5250	9343	1383	3155	2161	5265	16.50	16.35	80.17	1.523
5 600 521 679 605 Av. per cow	145%	4	3207	4699	9590	1431	2363	1623	4726	16.04	16.78	68.34	1.445
			3144	4212	9373	1421	1867	1279	4309	15.57	16.40	59.97	1.392
			3429	5870	10314	1493	2485	1702	4913	16.28	18.05	71.31	1.457
			3180	4741	9013	1333	6542	4481	7465	15.90	15.77	92.14	1.551
			3232	5563	8588	1286	3848	2636	5599	16.16	15.03	88.91	1.588
6 085 082 779 537 Av. per cow	175%	4	3347	8014	3879	1335	7183	4921	8090	16.74	15.54	140.03	1.750
			3129	8078	8297	1236	6759	5247	8121	15.65	14.52	145.05	1.786
			2869	8014	8163	1205	7609	5212	7915	14.44	14.28	142.85	1.804
			2997	7636	8189	1221	7164	4907	7397	14.98	14.33	136.77	1.777
			3090	7948	8382	1249	7404	5072	7933	15.45	14.67	141.17	1.780

Third Lactation Period

At the beginning of the third year it was deemed advisable to make several changes. It was evident that the cows in the group receiving only 85 percent of the Haecker Standard were being underfed to such an extent that this level was proving unprofitable. It was therefore discontinued. Under conditions of the experiment it seemed desirable to increase the feed of the remaining groups and substitute other cows where necessary. First, one group was added to take the place of group 1 which had been dropped. This group became group 2 and was fed 100 percent of Haecker Standard. Group 2 was changed from 100 percent to 115 percent of the Haecker Standard, group 3 was changed from 115 percent to 130 percent, group 4 was changed from 130 percent to 145 percent, and there was added group 6 which was fed 175 percent of the Haecker Standard. These increases apply to production requirements only and not to maintenance requirements. There were four cows in each group but one had to be dropped from group 2 before completing the year's test. Tables 5 and 6 give somewhat detailed information concerning the third year's test.

Group 2 receiving 100 percent Haecker Standard was composed of cows that had not been in the previous tests and, as in the first year's work, this group appeared to be able to produce more milk because of good condition resulting from feed and influences prior to the test. This group averaged 4455 pounds of milk, while group 3 receiving 115 percent Haecker Standard averaged 4354 pounds, although they were fed 1732 pounds of total digestible nutrients for production against 1589 pounds total digestible nutrients for group 2. On the other hand, the average loss in live weight per cow in group 2 was 45 pounds against 19 pounds in group 3. All of the other groups gained in weight as follows: Group 4, 38 pounds; group 5, 14 pounds; and group 6, 76 pounds. The value of milk over cost of feed, the cost of total digestible nutrients, and the feed cost of 100 pounds of milk are shown in table 7.

Table 7. Summary of results of feeding at five different feeding levels.

Groups of cows	2	3	4	5	6
Milk value over cost of feed	\$17.40	\$10.61	\$16.29	\$11.23	\$4.03
Cost of 100 pounds of total digestible nutrients	1.356	1.458	1.523	1.588	1.780
Feed cost of 100 pounds of milk	1.210	1.356	1.329	1.421	1.556

The cows in group 6 were given about all the feed they could consume, and the production probably represents their maximum ability to produce. The average production was 9075 pounds of 4 percent milk, the average weight per cow was 879 pounds, and the average gain in weight during the year was 76 pounds. Notwithstanding the excellent yield, the difference between value of the milk and the costs of feeds at the prices allowed was only \$4.03 per cow. These results, in comparison with results from the other groups, fail to confirm the idea held by some that it is always profitable to feed good cows to the limit of their capacity. Not only does the cost of 100 pounds of digestible nutrients increase with larger quantities of feed, but above certain limits more feed is required to produce a unit of milk than is required for medium or low production.

Discussion of Results

Reviewing the experiment as a whole the indications are that, with the conditions under which the animals were kept and with the feeds given them, the following conclusions may be drawn:

With the feeds given, consisting largely of those grown locally—lespedeza and Johnson grass hay, sorghum silage, cottonseed meal, and corn—dairy cows should receive more total digestible nutrients than is recommended by the Haecker Standard. This is necessary for good production, for economical production, and for maintaining the health and vigor of the cow.

The cows receiving 85 percent of the Haecker Standard, as well as those being fed on a level with this Standard, were able to give a fair yield of milk during the first lactation period of the tests, producing 90 percent of the expected yield; but during the second year of the test these two groups fell to 46 percent and 56 percent of the expected. At the lowest feed level the cows in group 1 lost in the 2 years 179 pounds live weight per cow. They were in such poor condition at the end of the second lactation period that it became necessary to drop them from the experiment.

Those receiving the Haecker Standard, group 2, while in much better condition than the cows in group 1, lost 92 pounds per cow in the 2 years and production dropped from 5404 pounds the first year to 3451 pounds of 4 percent milk in the second year of the test. The cows in this group that were continued on test the third year, with an increase in the feed for production to 15 percent above the Haecker Standard, were unable to regain their normal production and actually averaged less than during the preceding lactation period. It was not until after these experiments were completed and the cows had several months rest and good pasture that they were able again to show satisfactory production as indicated in the fourth lactation period during which time the cows had access to pasture.

Table 8 gives a general summary of the experiment during the first, second, and third lactation periods.

Cost of Total Digestible Nutrients

In the South, most dairymen use cottonseed meal liberally, some perhaps excessively. On this account the concentrates as a rule contain a rather high percentage of protein, more than is recommended as essential. The problem is one of supplying sufficient total digestible nutrients of good quality to meet the requirements. Using the prices for feed and milk production assumed in this report, the price of 100 pounds total digestible nutrients increases gradually with each rise in the feeding level, as is shown in table 9.

Table 9. Costs of 100 pounds total digestible nutrients at six feeding levels

Feeding level	1st year	2nd year	3rd year	Average
	dol.	dol.	dol.	dol.
85% Haecker	1.394	1.298	.....	1.346
100% Haecker	1.419	1.389	1.356	1.388
115% Haecker	1.490	1.564	1.458	1.504
130% Haecker	1.612	1.674	1.523	1.603
145% Haecker	.....	.....	1.558	1.558
175% Haecker	.....	.....	1.780	1.780

At the different levels of feeding, the feed cost of 100 pounds of 4 percent milk for each lactation period and for each feeding level is shown in table 10.

Table 10. The feed cost per 100 pounds of 4 percent milk at six feeding levels.

Feeding level	1st year	2nd year	3rd year	Average
	dol.	dol.	dol.	dol.
85% Haecker.....	0.956	1.367	.....	1.161
100% Haecker.....	1.116	1.304	1.294	1.238
115% Haecker.....	1.111	1.200	1.357	1.223
130% Haecker.....	1.178	1.261	1.330	1.256
145% Haecker.....	.....	.....	1.421	1.421
175% Haecker.....	.....	.....	1.555	1.555

Table 11 gives the amount and value of milk and the value of the milk over the cost of feed for each lactation period.

This table shows that the largest average returns from milk over feed cost were secured from the group fed only 85 percent of the Haecker Standard. While this is true, the decreased yield in the second year and the loss in live weight indicated that such feeding would be unwise. On the other hand, the results indicate that while the general trend in the yield of milk was rapidly upward with the increase in feed, the cost of the feed also increased to the extent that after the amount of feed given passed 130 percent of the Haecker Standard the returns above feed cost diminished to where the cost of the feed was almost equal to the value of the milk.

Table 12 gives the total digestible nutrients requirements for each year for maintenance and production, together with the percentage used for each at different feeding levels.

Relation of Price of Feed to the Market Value of Milk

Certain values of feed and milk were assumed as the basis of this experiment, and the returns above feed cost have been based on these assumed prices. It is realized that the prices of feed and of milk will vary, oftentimes feeds being high-priced as compared with the returns from the milk, and at other times the results will be in favor of milk on account of rather low prices of feeds. Tables 13 and 14 include a few illustrations which should enable the dairyman to determine for himself the influence of such prices on his net returns, and perhaps this information may enable him to select the feeding level that he should adopt. It will be noted that the feeding levels used for illustration were those employed in the tests included in this report.

The relationship that roughages should bear to concentrates is often a question in determining the ration for the dairy cow. Most good dairy-men are inclined to use roughages as far as possible, as such feeds are as a rule cheaper and can be more easily grown on the farm than the concentrates. Table 15 gives the relative amount of roughages and concentrates that were fed at each of the feeding levels used in the experiment.

Fourth Lactation Period: Results under College Herd Management Practices

As originally planned, this experiment was to have closed at the end of the third lactation period, but in order to make the results as complete as possible it was decided that cows that had been in the test in the first, second, and third years of the test should be carried a full year under the conditions, feed, and management given the College herd. Among the objectives sought in the continuation of the tests were:

1. To see if the cows given the scant rations for one or more years could be brought back to normal production.
2. To determine the estimated value of pasture, based on the price of total digestible nutrients when the cows received no pasture.
3. To determine the returns of the cows above cost of feeds as compared with the returns of the same animals without pasture.

There were remaining in the College herd available for such a test, four cows of group 1 which received during the experimental periods 85 percent of the Haecker Standard for production, and which had to be dropped at the end of the second lactation period on account of their poor physical condition. Groups 2 and 3 had each three cows available for the additional test. These 10 cows were placed back in the College herd, given a good rest, and after again calving were fed and handled in the same way as the rest of the herd, being furnished pasture when available. In feeding the general herd, the cows were fed approximately Haecker Standard for maintenance plus 115 percent of this Standard for production. This College herd practice was used as the basis for feeding the cows in the fourth year of experimental work.

Tables 16 and 17 give the results of this additional year's test.

All of the cows reported were in the first year's test in one of group 1, 2, or 3. Most of them were in the second year's test and some were in the test for each of the 3 years. The cows were divided into the three groups to which they were assigned in their previous lactation periods. During this fourth lactation period all were given the same treatment and fed on the same basis as the other cows in the College herd. In estimating the feed requirements of the high-producing cows in this herd, there is used as an average for production 15 percent above Haecker's feeding standard with no increase over the standard for maintenance. The average weight of cows in group 1 at the close of the second period was 800 pounds. At the beginning of the fourth year their average weight had increased to 984 pounds. At the end of this, the fourth period, it had increased to 1019 pounds. In group 2 the average weight at the end of the second year was 710 pounds and at the beginning of the fourth year 852 pounds, increasing during the fourth year 8 pounds. Group 3 averaged at the close of the second lactation period 848 pounds and at the beginning of the fourth lactation period 911 pounds, gaining 12 pounds each during the fourth period.

The cows in groups 1 and 2 in the second year's test averaged only 3342 pounds milk. In the fourth year the average was 7063 pounds or over twice as much as the second year. Total digestible nutrients in the second year's test were 3323 pounds and that given in the fourth year (not in-

Table 15. Relation of roughages to concentrates in six different feed levels for dairy cows.

Feeding level	Group	First year						Second year						Third year					
		Total digestible nutrients			Total digestible nutrients			Total digestible nutrients			Total digestible nutrients			Total digestible nutrients			Total digestible nutrients		
		Roughage		Concentrates		Roughage		Concentrates		Roughage		Concentrates		Roughage		Concentrates		Roughage	
		lbs.	percent	lbs.	percent	lbs.	percent	lbs.	percent	lbs.	percent	lbs.	percent	lbs.	percent	lbs.	percent	lbs.	percent
85%	1	2925	66.2	1496	33.8	2824	82.9	584	17.1										
100%	2	2741	64.5	1511	35.5	2441	75.4	797	24.6					2955	73.9	1038	26.1		
115%	3	2877	54.0	2451	46.0	2685	58.1	1934	41.9					2612	61.5	1433	35.5		
130%	4	2732	44.0	3560	56.0	2828	47.2	3158	52.8					3104	59.0	2161	41.0		
145%	5													2963	52.9	2636	47.1		
175%	6													2861	36.1	5072	63.9		

cluding pasture) were 3526 pounds. At the time these cows were started on the first year's test, their average age was 6 years and 10 months, and based on previous records their expected average yield was 6389 pounds of 4 percent milk. At the beginning of the fourth year's test their average age was 9 years and 11 months, and the average yield was 7006 pounds of 4 percent milk or 617 pounds more than their expected yield at the age of 6 years and 10 months.

For a general analysis of this fourth year's record, since all the cows used during this lactation period were kept under the same environment and fed approximately the same feed, the results of the three groups may be averaged. These averages are compared in table 18 with the averages of the groups in the first 3 years' tests receiving the Haecker Standard plus 15 percent of the production requirements recommended.

Although the cows in group 1 not on pasture were fed 15 percent above Haecker Standard requirements they failed to produce up to their capacity, while the cows in group 2 on pasture exceeded their expected yield by 617 pounds of milk. Not including the amount received from pasture, the cows in group 2 received only 3272 pounds of total digestible nutrients, while those in group 1 consumed 4666 pounds. On the basis of requirements, it is estimated that the cows in group 2 received 2039 pounds or 38.4 percent of total digestible nutrients from the pasture.

The cost of feed, not including pasture, was \$70.25 per cow for group 1, and \$48.58 per cow for group 2. The value of the milk produced over cost of feed was, for group 1, \$22.74, against \$63.52 for group 2, a difference of \$40.78. Basing the value of total digestible nutrients furnished by pasture on the cost of that furnished in feed, the pasture value amounts to \$30.28 per cow. The cows in group 2 were in much better physical condition at the close of the fourth year than at the close of any of the preceding years when they were not on pasture. They gained an average of 18 pounds per cow during the year on pasture, but lost 18 pounds while in group 1 and receiving no pasture. The feed cost of cows in no-pasture group 1 was \$1.21 per 100 pounds of milk, while that of pasture group 2 (not including the cost of pasture) was 69 cents per 100 pounds of milk.

Table 16. Feed consumption and costs for dairy cows under management practice of the State College herd: fourth year.

Original group	No. of cows	Feed given and nutrient content								Yearly T.D.N. lbs.	Value of feed eaten				Total cost of feed dol.
		Hay		Sorghum Silage		Concentrates		Hay \$10.00 per ton dol.	Silage \$3.50 per ton dol.		Concentrates \$30.00 per ton dol.				
		Consumed lbs.	T.D.N. lbs.	Consumed lbs.	T.D.N. lbs.	Consumed lbs.	T.D.N. lbs.								
1	4														
		2177	1095.0	2699	407.6	1952	1534.4	3037	10.89	4.72	29.28	44.89			
		2387	1200.7	3424	517.0	1351	965.3	2883	11.94	5.99	20.27	38.20			
		2028	1020.1	3492	527.3	2143	1601.6	3149	10.14	6.11	32.14	48.39			
		2126	1069.4	2456	370.9	2347	1696.7	3137	10.63	4.30	35.21	50.14			
Av. per cow		2179	1096.2	3018	456.0	1948	1450.0	3002	10.90	5.28	29.22	45.40			
2	3														
		3328	1674.0	3308	499.5	1712	1574.5	3748	16.64	5.79	25.68	48.11			
		2764	1390.3	2434	367.5	2583	1950.2	3708	13.82	4.26	38.75	56.83			
		2132	1072.4	3069	463.4	2211	1616.2	3152	10.66	5.37	33.17	49.20			
		2741	1378.9	2937	443.5	2169	1713.6	3536	13.71	5.14	32.53	51.38			
Av. per cow															
3	3														
		1417	712.8	6356	959.8	1955	1440.4	3113	7.09	11.12	29.33	47.54			
		1820	915.5	3492	527.3	1785	1338.2	2781	9.10	6.11	26.78	41.99			
		3202	1610.6	2699	407.6	2449	1920.8	3939	16.01	4.72	36.74	57.47			
		2146	1080.0	4182	632.0	2063	1566.0	3278	10.73	7.32	30.95	49.00			
Av. per cow															

Table 17. Production and live weight of dairy cows under management practice of the State College herd: Fourth year.

Original groups	No. of cows	Age		Days in milk	Produce ^d 4% milk	T.D.N. eaten; pasture not included	T.D.N. required Morrison Standard		Total T.D.N. required	T.D.N. credited to pasture	Live weight		Value of 4% milk @ \$1.60 per 100 lbs.	Value of feeds	Value of milk over cost of feed
		yrs.	mos.				For maintenance	For production			Begin-ning	At close			
				no.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	dol.	dol.	dol.
1	4														
027		10	11	325	7325	3037	3019	2373	5392	2355	975	1080	117.20	44.89	72.31
513		10	6	245	4848	2683	3143	1571	4714	2031	1065	1125	60	38.20	37.37
541		9	2	365	9705	3149	2511	3144	5655	2506	835	890	55	155.28	106.89
013		12	3	352	6851	3137	2694	2220	5114	1977	1060	980	-80	50.14	59.48
Av. per cow		10	8	322	7182	3002	2892	2327	5219	2217	984	1019	35	114.42	69.01
2	3														
662		7	2	287	5723	3748	2383	1854	4237	489	740	820	80	48.11	43.46
517		11	2	336	6901	3708	2767	2236	5003	1295	990	900	-90	56.83	53.59
094		5	11	305	8211	3152	2511	2660	5171	2019	825	860	35	131.38	82.18
Av. per cow		8	1	309	6945	3536	2554	2250	4804	1268	852	860	8	111.12	59.74
3	3														
072		9	1	308	6028	3113	2767	1953	4720	1607	900	975	75	96.45	48.91
300		14	7	355	7036	2781	2511	2280	4791	1291	860	845	-15	41.99	70.59
553		9	4	315	7606	3939	2767	2404	5231	1292	975	950	-25	121.70	64.23
Av. per cow		11	0	326	6890	3278	2682	2232	4914	1636	911	923	12	110.24	61.24

Table 18. A comparison of cows fed 15 percent above the Haecker Standard for production plus standard for maintenance, with the same cows on pasture.

	Group 1 10 cows: Haecker Standard plus 15 percent of Standard for production	Group 2 10 cows: Haecker Standard plus 15 percent of Standard for production
	Average per cow per year	Average per cow per year
	No pasture	On pasture
4 percent milk per cow, pounds	5812	7006
Weight of cows at beginning, pounds	867	916
Weight of cows at close, pounds	849	934
Gain or loss in weight, pounds	— 18	— 18
Value of milk @ \$1.60 per 100 pounds	\$92.99	\$112.10
Feed:		
Hay, pounds	2970	2355
Silage, pounds	8523	3379
Concentrates, pounds	2699	2060
Cost	\$70.25	\$48.58
Total digestible nutrients:		
Hay, pounds	1541	1185
Hay, percent	33.0	22.3
Silage, pounds	1183	510
Silage, percent	25.4	9.6
Concentrates, pounds	1942	1577
Concentrates, percent	41.6	29.7
Totals, pounds	4666	3272
Totals, percent	100	61.6
Cost of total digestible nutrients per 100 pounds	\$1.506	\$1.485
Total digestible nutrients required:		
For maintenance, pounds	2887	2701
For production, pounds	1779	2610
Total, pounds	4666*	5311**
Pasture:	None	1½ acres per cow (Est.)
Estimated total digestible nutrients from pasture, pounds	-----	2039
Estimated total digestible nutrients from pasture, percent	-----	38.4
Value of milk over cost of feed	\$22.74	\$63.52
Feed cost of 100 pounds milk	\$1.209	\$0.693
Value of total digestible nutrients furnished by pasture		\$30.28

* Amount fed.

** Total digestible nutrients required is obtained by multiplying production requirements by 115 and adding to maintenance requirements.

Conclusions

Based on the results of experiments extending over a period of 4 years to show the relation between the feed of the cow and her production, the following conclusions may be drawn:

1. The economy of a dairy ration depends quite largely upon the ability of the cow, the relative prices of the feeds as compared with those of the dairy products, and the effect of the quantity and quality of the feed on the health and physical vigor of the cow.

2. The cost of 100 pounds of total digestible nutrients will increase, as a rule, with the increase of total nutrients fed.

3. Other things being equal, the ratio of total digestible nutrients in the concentrates as compared with that in the roughages will increase with the increase in nutrients fed.

4. The indications are that when the cows carry a considerable amount of flesh when fresh, they may for comparatively long periods produce milk at less cost per hundredweight when underfed than when given liberal rations, but the final results will be undue loss in live weight, poor physical condition, and finally a marked decrease in production.

5. Satisfactory results were not secured by feeding either the 85 percent or the 100 percent ration recommended by the Haecker Standard.

6. Rations containing 115-130 percent Haecker Standard proved most economical.

7. While the yield of milk was increased by feeding rations containing 175 percent of Haecker Standard the returns over feed cost were rapidly reduced.

8. The relation of the amount of roughage (which should always be of high quality, if possible) and concentrates to be fed to dairy cows will depend upon the size of the cow, her ability as a producer, and the relative prices of milk and feed.

9. Cows that were fed from 1 to 3 years at comparatively low feeding levels without pasture and as a result showed loss in live weight, a general unthrifty condition, and low milk production, were turned on pasture, fed liberally, given a rest period, and during their next lactation period an accurate record was kept of their feed and production. During this period the cows were fed approximately the requirements of the Haecker Feeding Standard for maintenance plus 115 percent of this Standard for production. The results show (a) that such cows can be brought back to normal production (b) that a good pasture is not only a cheap feed but one of the best in maintaining the health and vigor of the animal.

ORGANIZATION AND OPERATION OF FARMS

WITH

SUGGESTED ADJUSTMENTS

IN THE

BROWN LOAM AREA, MISSISSIPPI

<u>FARM TYPE</u>	<u>DAYS OF EMPLOYMENT</u>	<u>NET FARM INCOME (DOLLARS)</u>				
		100	200	300	400	500
COTTON	146					
COTTON-CATTLE	157					
COTTON-DAIRY	198					

Man-days of employment and "normalized" net farm incomes from average one-mule size farm organized as cotton, cotton-cattle, and cotton-dairy types, Brown Loam Area, Mississippi.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, DIRECTOR
STATE COLLEGE, MISSISSIPPI



This is another in a series of Area Farm Management studies designed to provide a general picture of farm resources, farm organization and operation, and adjustment problems. It is expected that these area studies will be followed by a more detailed type of farm management analysis based on a system of detailed record-keeping by farmers themselves. The two types of studies will complement each other and the two should provide the necessary information for an understanding of farm management problems by areas and should point the way toward both short- and long-time adjustments for a sounder agriculture within the State.

Appreciation is extended to the General Education Board for grant of funds that have made this and other social and economic studies possible. Thanks are also extended to the Extension Service, Agricultural Adjustment Agency, and to the farmers who assisted and cooperated in the development of this study.

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ORGANIZATION AND OPERATION OF FARMS WITH SUGGESTED ADJUSTMENTS IN THE BROWN LOAM AREA, MISSISSIPPI

By W. G. O'LEARY

Low farm incomes, depletion of natural resources, underemployment of farm people, and inadequate institutional services are characteristics of rural life in Mississippi that have prompted the undertaking of this study. Information is needed on the organization and operation of the systems of farming now in operation, and on adjustments that might be made to enable a better utilization of natural resources and a more nearly year-round employment to the end that more adequate incomes might be earned by farm people.

Scope and Objectives

An appraisal is made of the systems of farming prevailing in the area during the pre-war period, with a view of pointing out possibilities of adjustments in farm organization and management practices that will result in more efficient utilization of land and other resources and in higher farm incomes. Also a brief description is given of the general economic conditions and trends that have influenced the development of the present systems of farming.

Since the Brown Loam Area extends the entire length of the State from north to south, there is some diversity in climate, crops, and market facilities. For this reason the area has been divided for study. This study deals specifically with the central and southern portions including Madison, Warren, and the seven Brown Loam counties to the south of these. See figure 1.

The findings will be applicable only in part to the northern counties of the area. It is intended that a subsequent study will be made dealing specifically with that part of the area, especially that included in the Memphis Milk Shed Area.

The main objectives which the study attempts to accomplish may be stated as follows: (1) To describe the present agriculture of the area in terms of land-use, cropland organization, size of farms, type of farms, tenure of operators, and other factors related to organization and operation of farms; (2) to make a cost-income analysis of different sizes and types of farms, (3) to make time studies of standard farm operations on varying sizes and types of farm organization; (4) to determine some of the major agricultural problems in the area; (5) to suggest adjustments which will help to solve these problems; (6) to ascertain obstacles which impede the accomplishment of needed adjustments and to suggest ways of removing these obstacles, and (7) to estimate the effect of suggested adjustments on the agriculture of the area.

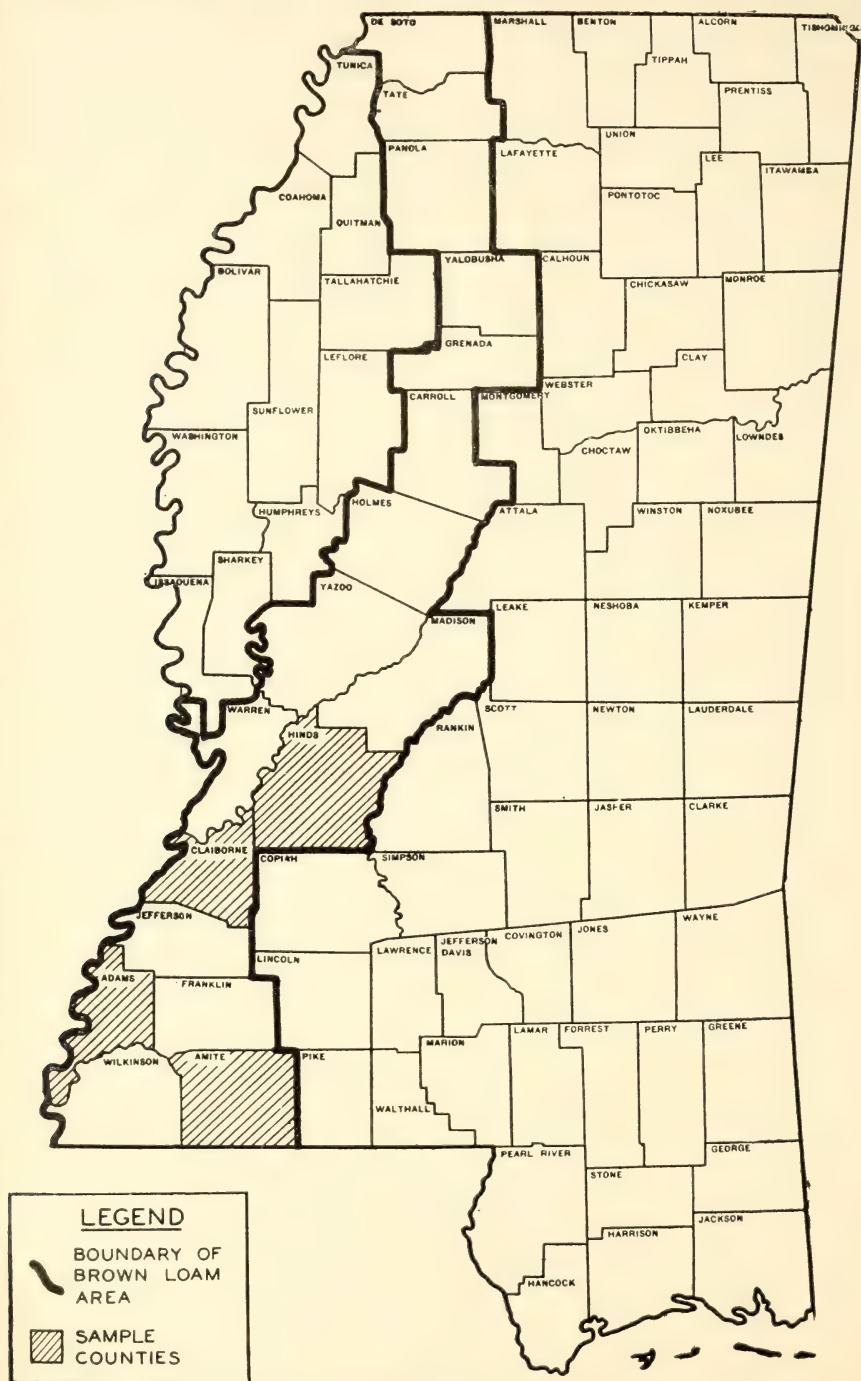


Figure 1. Location within the State of the Brown Loam Area and of the sample counties studied.

Method of Study

The information used to reflect the general economic conditions and historical trends in the area was secured from the U. S. Census and other secondary sources. Data on the organization and operation of farms were obtained through interviews with farm operators on sample farms in Adams, Amite, Claiborne, and Hinds Counties for the 1941 crop year. The schedule method was employed to secure the data, and complete information necessary to calculate net farm income was obtained in each case.

Selection of Sample Farms

The sample of farms to be studied were selected at random from the AAA farm worksheets in the four sample counties. Sixteen percent of the work sheets were drawn from the files from which the data on cropland organization were obtained. Questionnaires were then mailed to the operators of these farms to determine the classes and numbers of livestock on the farms and the value of sales from livestock and livestock products. Approximately 60 percent of the questionnaires were returned. The cropland and livestock organizations were then combined for the farms on which both were available. These farms representing approximately 10 percent of all farms in the four counties, were sorted into owner and tenant-operator groups. Next, the farms were sorted into five type classes: cotton, cotton-cattle, cotton-dairy, cotton-livestock, and miscellaneous. Within each of these tenure and type classes, the farms were then sorted into groups of one-family, two-family, and three-or-more-family size farms. The one-family size farms were further sorted into one-mule and two-mule size farms, depending on the number of workstock used. These groups were then arrayed on a crop acreage basis from lowest to highest. The sample farms were then drawn from the middle of these groups, representing the average sizes for the different classes of farms. Thus the farms were stratified into groups of close similarity so that the sample farms selected in each group were quite homogenous. The sample farms studied numbered 140 and were sorted into 14 size-type-tenure groups.

Definitions of Terms

Operating unit: Refers to the management unit; it is all the land included in one AAA contract, is cultivated by one set of workstock and equipment, and is generally a contiguous tract. It may include the land cultivated by more than one family but does not refer to separate plots farmed by croppers or nonmanaging tenants.

Farm: Synonymous with operating unit.

Farm organization: The combination of crop and livestock enterprises found on a farm.

Farm type: A class of farms having a high degree of similarity in the combination of crop and livestock enterprises. The basis used in classifying farms by types is explained on page 24.

Operator: The person who is responsible for management of an operating unit. He may be an owner, a farm manager, or a tenant who exercises chief control over his farming operations. The term does not refer to sharecroppers or other tenants who are supervised in their farming operations.

Farm land: All land included in the farm.

Cropland: Land in crops and idle land ordinarily planted to crops.

Net farm income: The returns to a family from its farming operations after all farm expenses have been deducted.

Farm investment: The values of real estate, farm equipment, workstock, and livestock.

Interest on investment: The amount calculated by applying an interest rate of 5 percent to the farm investment.

Family labor earnings: The returns accruing to the family for labor and management after all charges against farm income have been deducted. It is calculated by deducting interest on investment from net farm income.

GENERAL CHARACTERISTICS OF AREA

The Brown Loam Area comprises a relatively narrow belt of soil extending the entire length of the State from north to south and running approximately parallel to the Yazoo-Mississippi Delta and the Mississippi River, which together form its western boundary. The breadth of the area is somewhat irregular, with the widest part at the south extreme where it extends some 60 or 70 miles. See figure 1.

Physical Factors

The soils of the Brown Loam Area are composed principally of uplands which include the Memphis, Grenada, and Lexington Series. These soils are characterized by the top layer of loessial or brown loam material, which is thought by most authorities to have been laid down by the wind. The layer of brown loam material is deepest in the bluff hills of the western side of the area where it reaches a depth of some 50 feet. To the east, in the more level areas, it diminishes to only a few inches in depth and gradually but irregularly merges with the Coastal Plain material which composes its eastern border. These soils in their original state are fertile and quite productive, but continuous row-cropping and lack of erosion control have greatly reduced their productivity.

Intermingled with the upland soils are the terrace soils which include the Richland, Litanian, Oliver, Calhoun and Carroll series and the one bottom soil of the Vicksburg series. These terrace and bottom soils are quite productive and very desirable.

The topography is quite rugged with steep hills and many small valleys in parts of the area, especially in the bluff hills of the western side where the deep layer of brown loam material is found. Because of the steep slopes here, the upland soils are subject to severe erosion damage when cultivated.

Climate

Reports of the U. S. Weather Bureau indicate considerable diversity in the climatic factors from the northern to the southern extremes of the Brown Loam Area. The average annual precipitation ranges from 50 inches in the northern portion to 60 inches in the southern portion. The length of the growing season ranges from 210 frost-free days in the northern portion to 250 in the southern portion. In the part of the area where this study is applicable, the average annual rainfall ranges from 54 to 60 inches, and the growing season from 240 to 250 days.

Economic Factors

The general economy of the Brown Loam Area, like that of the State as a whole, is based primarily on agriculture. There are few large towns and comparatively little industry other than farming and the businesses subsidiary to its prosecution. There has been a marked tendency, however, toward urbanization in the area during the past 40 years.

Population

The population of the 9 counties increased 13.7 percent during the past 40 years, as compared to an increase for the State as a whole of 41 percent. See table 1. The proportion of rural population in the area decreased from 84.3 percent in 1900 to 61.7 percent in 1940. The same general trend occurred in the population of the State as a whole, where the proportion of rural population decreased from 92.3 to 80.2 percent during this period.

Table 1—Total population, composition, and trends, Brown Loam Area and State, 1900-1940.

Brown Loam Area ¹					
Item	1940	252,643	1920	1910	1900
Total population	288,740	1930	219,347	251,831	254,001
Percent Negroes	62.1	61.7	65.7	71.1	74.5
Percent rural	61.7	64.6	74.1	77.0	84.3
The State					
Total population	2,183,796	2,009,821	1,790,618	1,797,114	1,551,270
Percent Negroes	49.2	50.2	52.2	56.2	58.5
Percent rural	80.2	83.1	86.6	88.5	92.3

¹Composed of the nine counties included in the study. Source: United States Census.

The proportion of Negroes to the total population in the area decreased from 74.5 percent in 1900 to 62.1 percent in 1940. For the State as a whole the decrease was from 58.5 to 49.2 percent.

Table 2.—Total number of farms and percentage distribution by size groups, based on total farm land, Brown Loam Area and the State, 1900 and 1940

Year	Under 10 acres	10-19 acres	20-49 acres	50-99 acres	100-174 acres	175-259 acres	260-499 acres	500 acres and over	Total farms
Brown Loam Area ¹									
1940	6	26	38	13	9	3	3	2	23,097
1900	5	17	47	14	9	3	3	2	31,989
The State									
1940	6	26	34	16	10	3	3	2	291,102
1900	3	16	38	18	14	5	4	2	220,503

¹Composed of nine counties included in the study. Source: United States Census of Agriculture.

Agricultural Trends

The average farm acreage per family is smaller in the Brown Loam Area than in the State as a whole. It has increased in both during the past 40 years. According to the census classification, 70 percent of the farms in the area had 50 acres or less of total land in 1940, and 69 percent fell in this size group in 1900. For the State as a whole, 66 percent of the farms had 50 acres or less of total farm land in 1940, and 57 percent fell in this size group in 1900¹. See table 2.

The total land in farms of the area has decreased by 254,836 acres, or 10.7 percent, since 1900. Improved land, which includes cropland and plowable pasture, decreased by 21,330 acres, or 18 percent, during the past 40 years, and since 1910, woodland on farms decreased 21 percent, and "other land in farms" increased 56,214 acres, or 27 percent. See table 3. A large proportion of this land is waste, including barren and gullied land. The trend for the State as a whole has been in the opposite direction: total land in farms increased 5 percent during the 40-year period, and improved land increased 40 percent. These figures indicate that the agriculture of the area has been on a decline since 1900 in both the total acreage of land in farms and the proportion of farm land in productive use.

Table 3—Total land in farms and land use, Brown Loam Area and the State, 1900 and 1940

Year	Total land in farms	Improved land in farms	Woodland in farms	All other land in farms
Brown Loam Area¹				
1940	2,122,103	1,164,854	694,506	262,183
1900	2,376,939	1,186,184	874,756 ²	205,969 ²
The State				
1940	19,156,058	10,702,733	6,068,121	2,385,204
1900	18,240,736	7,594,428	7,883,558 ²	1,665,665 ²

¹Composed of the nine counties included in the study.

²Figure as of 1910.

Source: United States Census of Agriculture.

Farm Tenancy

The proportion of farm tenancy in the Brown Loam Area is higher than for the State as a whole. In 1940 the proportion of tenancy in the area was 70.1 percent, as compared to 66.2 percent for the State. The trend in tenancy for the area has been in the opposite direction to that for the State during the past 40 years. During this period tenancy declined in the area from 76.8 to 70.1 percent. For the State as a whole, tenancy increased from 62.4 to 66.2 percent. See table 4.

¹The census classifies each owner-operator, tenant, cropper, or manager as a farmer, and the land cultivated by each as a farm.

**Table 4—Percentage of total farmers who are tenants,
Brown Loam Area and the State, 1900-1940**

Area	1940	1930	1920	1910	1900
Brown Loam ¹	70.1	74.4	70.3	75.4	76.8
The State	66.2	72.2	66.1	66.1	62.4

¹Composed of the nine counties included in the study. Source: United States Census of Agriculture.

Shifts in Farm Organization and Production

There has been a rather marked tendency away from the production of cash crops toward a subsistence and livestock type of farming in the Brown Loam Area during the past 40 years. This trend is shown in the number and kinds of livestock kept and in the acreages of different crops grown, as well as in the proportions of farmers' incomes from different sources.

The acreage of cotton in the area has decreased from 475,435 acres in 1900 to 197,832 acres in 1940, or by 58.4 percent. The reduction in the State as a whole during this period was only 15.5 percent. The acreages of feed crops in the area greatly increased during this period. Corn increased only 1.5 percent, while hay crops increased 73.5 percent and oats 52.6 percent. The corresponding increases for the State during the period were very much more than those just mentioned. The state increase in corn acreage was 29.9 percent, in hay acreage 728 percent, and in oats 55.5 percent. See table 5.

Table 5—Acreages of selected crops for the Brown Loam Area and for the State, 1900 and 1940

Year	Corn	Hay crops	Cotton	Oats	Sorghum	
					For syrup	Silage and hay
Brown Loam Area ¹						
1940	306,139	50,659	197,823	6,360	5,815	2,116
1900	301,553	29,204 ²	475,335	4,169	2,802	1,359 ³
Percentage change	+1.5	+73.5	—58.4	+52.6	+107.5	+55.7
The State						
1940	2,957,498	821,973	2,449,385	135,422	56,836	31,242
1900	2,276,313	99,261 ²	2,897,920	87,066	27,286	.....
Percentage change	+29.9	+728.0	-15.5	+55.5	+108.3	.....

¹Composed of the nine counties included in the study.

²This figure is for the year 1910 and includes all hay exclusive of sorghum.

³This figure is for the year 1920.

Source: United States Census of Agriculture.

The total numbers of mules, horses, and colts decreased in the Brown Loam Area 33.7 percent from 1900 to 1940. For the State as a whole, the decrease amounted to only 1.5 percent. All cattle and calves in the area increased 53.1 percent during the 40-year period. For the State as a whole the increase was 32.8 percent. Beef cattle in the Brown Loam Area increased 162.4 percent during the period, while dairy cattle increased only 23 percent. For the State as a whole, dairy cattle increased 84.7 percent while beef cattle increased 45.5 percent. There was a great decrease in hogs

and sheep, both in this area and in the State as a whole, during the 40-year period. In the Brown Loam Area hogs decreased 16.1 percent, sheep 70.3 percent, and in the State, decreases were 14.8 and 80.7 percent, respectively. See table 6.

Table 6—Numbers and kinds of livestock on farms for the Brown Loam Area and for the State, 1900 and 1940

Year	Horses and colts	Mules and colts	Cattle and calves			Hogs and pigs	Sheep and lambs
			Total	Over 2 yrs. old			
Dairy	Beef						
Brown Loam Area ¹							
1940	16,017	29,722	185,634	50,398	42,085	133,231	5,373
1900	36,143	32,804	121,283	40,989	16,036	158,816	18,106
Percentage change	-55.7	-9.4	+53.1	+23.0	+162.4	-16.1	-70.3
The State							
1940	109,124	340,996	1,159,034	552,742	124,594	1,106,708	60,397
1900	229,311	214,259	873,086	299,318	85,629	1,299,498	312,632
Percentage change	-52.4	+59.2	+32.8	+84.7	+45.5	-14.8	-80.7

¹Composed of the nine counties included in the study.

Source: United States Census of Agriculture.

The proportion of farm income in the area from the sales of crops was 63.7 percent in 1930, while in 1940 it had decreased to 52.3 percent. The greater part of this decrease was offset in farm products used by the family, which increased from 19.5 percent of the total in 1930 to 31 percent in 1940. A smaller part of the decreased proportion of crop sales was offset by the sale of livestock and livestock products, which increased from 14.4 to 15.4 percent of the total farm income during the 10-year period. This increase was all in livestock sales; there was no increase in the sale of livestock products.

The general trends for the State as a whole were the same during this period as for the Brown Loam Area. In the State, the proportion of farm income from the sale of crops is, however, greater than that in this area. In 1930 crop sales accounted for 73.7 percent of the State's total farm income, while in 1940 the proportion was 61.7 percent. The proportion of farm income composed of farm products used by the family increased from 16.3 percent to 27.4 percent, and the proportion composed of the sale of livestock and livestock products increased from 8.8 to 10.7 percent during this period. Unlike the Brown Loam Area, the State had the greater part of the increase in sales of livestock products rather than in sales of livestock. See table 7.

Based on the number of families concerned, farmers of the Brown Loam Area do not earn their proportionate share of the total payments made by the AAA to the farmers in the State. In 1940, 9.7 percent of the total farm families of the State were in this area. This proportion of payments was not attained in the area for any of the 6 years from 1936 to 1941. See table 8.

Table 7—Proportion of farm income by source, Brown Loam Area and State, 1930 and 1940¹

Percentage distribution by source							
Year	Total value of farm products sold, traded, or used at home	Livestock and livestock products sold or traded			Crops sold or traded	Farm produce used at home	Forest products sold
		Total	Livestock	Products			
Brown Loam Area ¹							
1940	100	15.4	7.8	7.6	52.3	31.0	1.4
1930	100	14.4	6.8	7.6	63.7	19.5	2.4
The State							
1940	100	10.7	4.1	6.6	61.7	27.4	.8
1930	100	8.8	3.4	5.3	73.7	16.3	1.3

¹Composed of the nine counties included in the study. Source: United States Census of Agriculture.

Table 8—Proportion of State's total AAA payments related to proportion of State's total farm families in the Brown Loam Area, and comparisons of proportion of available soil-building payments earned in Brown Loam Area to that of the State, 1936-1941

	1936	1937	1938	1939	1940	1941	Six-year average
Percentage farm families in area ¹	9.7	9.7	9.7	9.7	9.7	9.7	9.7
Percentage AAA payments to area	8.0	8.4	7.2	7.3	7.5	7.3	7.6
Percentage of available soil-building payments earned by areas							
Brown Loam Area	74.6	51.0	69.8	68.8	67.6	76.0	68.0
State	64.4	70.9	74.3	73.8	67.4	75.9	71.0

¹Area composed of the nine counties included in the study.

Source: Population figures from the United States Census of Agriculture; AAA payments from records of the State AAA office.

PRE-WAR AGRICULTURE

This study deals with farming conditions prevailing in the Brown Loam Area prior to our entrance into the war. The information regarding farm organization and operation was secured as of the 1941 crop year. Prices for items bought and sold by farmers and for farm products used by them in the home were adjusted to the average of prices prevailing in the area during the 5-year period, 1935-1939. The cotton yield was also adjusted for each farm to its 5-year average as determined by the AAA. These adjustments were made in an effort to lessen the effect of wartime inflation on comparative farm incomes and with a view of arriving at conclusions which more nearly represent "normal" farming conditions.

Size of Farms

In numbers, small farms predominate in the area. Approximately 75 percent of all farms are one-family size units; 13 percent are two-family size units, consisting of the operator and one tenant family; while the remaining 12 percent are farms with three or more families. See table 9. Over one-half of the one-family size farms, or approximately 44 percent of all farms in the area, have less than 20 acres of cropland and are cultivated with one head of workstock. The other one-family size farms use 2 head of workstock, and usually

have between 20 and 30 acres of cropland. Cropland on the multiple-family size farms is generally between 20 and 30 acres per family.

The larger farms are in general more diversified than the smaller farms. In the one-family size group of farms, 51 percent have cotton only as a cash enterprise, while in the two-family size group, the proportion is 43 percent, and in the group of farms having three or more families, the proportion is only 25 percent. See table 10. Economic pressure is so great on the operator of the smaller unit that he is forced to "mine his soil", through continued cropping to cotton, in order to retain title to his holding and to feed his family and his few livestock. The effect of size on farm employment and income is discussed under subsequent headings.

Table 9—Proportion of farms by size of operation, Brown Loam Area, 1941

One-family size			Two-family size	Three or more family size
Total one-family	Having one mule	Having two mules	Total	Total
Percent	Percent	Percent	Percent	Percent
75	44	31	13	12

Based on a 10 percent random sample of AAA worksheets in the four sample counties.

Tenure of Operators

Tenants compose approximately one-third of all farm operators in the area.¹ The land these tenants operate is, however, considerably less than one-third of the total, for the tenant-operated farms are concentrated in the smaller, one-family size farm group. There is also a close correlation between tenant-operated farms and the one-cash crop or cotton system of farming. While tenants operate 49 percent of all cotton farms, they operate only 18 percent of the more diversified farms. See table 10. Some of the reasons these

Table 10—Distribution of farms, and proportion of operators who are tenants by size and type groups, Brown Loam Area, Mississippi, 1941¹

Type of farm	One-family size		Two-family size		Three or more family size		All size farms	
	Number of farms	Percent tenant operated	Number of farms	Percent tenant operated	Number of farms	Percent tenant operated	Number of farms	Percent tenant operated
Cotton	232	55	30	17	16	19	278	49
Cotton with supplemental livestock	225	23	40	8	49	8	314	18
All farms	457	39	70	11	65	11	592	33
Percent of farms that are cotton	51		43		25		47	

¹Based on a 10 percent random sample of AAA worksheets in the four sample counties. For a definition of farm types, see page 24.

¹"Operator" is used in the sense as employed by the Agricultural Adjustment Agency and does not include croppers or renters who do not have AAA worksheets in their names.

two conditions exist are pointed out under the section on leasing arrangements.

Production Practices

The practices followed by farmers in their agricultural pursuits often are as much a determining factor for success or failure as is the type or the size of the farm they operate.

Fertilizers Used and Recommendations

The use of commercial fertilizers in the area is low and is confined almost entirely to cotton and corn, the two most important crops. By far the greatest use is for cotton, both in the acreages fertilized and in the quantity of materials used.

Forty-one percent of all farm operators in the area used no fertilizer on their cotton in 1941. On an acreage basis cotton was about equally divided between that fertilized and that not fertilized. A complete fertilizer of 4-8-4 analysis is the kind most widely used. It is used on 36 percent of all acres fertilized, the average rate of application being 204 pounds per acre. See table 11.

Nitrate of soda ranks second in the kinds of fertilizer used on cotton. It is used on 20 percent of all acres fertilized, the average rate of application being 109 pounds per acre. The other kinds of fertilizers used on cotton consist of mixtures of these two and of various other kinds and combinations. In addition to the commercial fertilizers used, winter legume crops are grown on an acreage equivalent to about 88 percent of the cotton acreage, on the sample farms studied. Figures are not available to show what proportion of these are grown on cotton land, but it is known that a considerable portion of them are grown on land to be planted to corn.

The general recommendation of Experiment Station agronomists for fertilizer on cotton is 600 pounds of 4-8-4 per acre. The net returns per acre, according to Experiment Station findings, increase with increased rates of application up to this amount.¹ Increased costs for additional fertilizer being deducted, 100 pounds of 4-8-4 increases the net returns by \$3.84, and 600 pounds increases the net returns by \$11.32 per acre. See table 12.

Estimates of increased yields from fertilizers secured from farmers in the study substantiate the Experiment Station findings as to increased yields through the use of fertilizer on cotton. On the average, farmers' estimates indicate that an application of 240 pounds of 4-8-4 increases the normal yield of lint cotton by 105 pounds per acre. For those using nitrate of soda, estimates indicate an increase of 64 pounds of lint through an application of 113 pounds per acre. See table 13. The farmers' estimates, like the Experiment Station's findings, indicate that a higher yield can be expected from a complete fertilizer for cotton than from nitrogen alone.

¹This recommendation is based upon fertilizer experiments conducted in the area when fertilizer of 4-8-4 analysis was available. Now that it is not available, the recommendations are for 6-12-6 analysis at the rate of 400 pounds per acre, or two-thirds that of 4-8-4, which contains the same quantity of fertilizer elements.

Table 11—Fertilizers used by kinds and by crops, Brown Loam Area, 1941

Proportion and average rates by kinds of fertilizer used										
	Proportion of farmers using fertilizer (Percent)	4-8-4			Nitrate of soda		Other kinds and combinations			
		Proportion of acres fertilized (Percent)	Percent of farmers using	Percent of acres fertilized	Average rates applied	Percent of farmers using	Percent of acres fertilized	5-year weighted average yield		
Cotton	59	50	39	36	204	32	20	29	44	222
Corn	41	30	20	16	150	70	61	10	23	15

Based on 140 farm schedules obtained in the area.

Table 12—Net increased returns per acre of cotton from varying application rates of 4-8-4 fertilizer, Brown Loam Area¹

Fertilizer used lbs.	Increased returns from fertilizer ²					Increased costs ²				Net return from fertilizer \$
	Seed cotton lbs.	Lint lbs.	Value \$	Seed lbs.	Value \$	Total value \$	Fertilizer \$	Picking \$	Ginning \$	
100	150	54	5.51	96	1.20	6.71	1.35	.98	.54	2.87
200	260	94	9.57	166	2.08	11.65	2.70	1.69	.94	5.33
300	345	124	12.65	221	2.76	15.41	4.05	2.22	1.24	7.53
400	430	155	15.81	275	3.44	19.25	5.40	2.80	1.55	9.50
500	505	182	18.56	323	4.04	22.60	6.75	3.23	1.82	10.75
600	560	202	20.60	358	4.48	25.08	8.10	3.64	2.02	11.32

¹Since fertilizer of 4-8-4 analysis is not available, a 6-12-6 analysis may be substituted at the rate of two-thirds that of 4-8-4. This will produce the same returns in seed cotton and in addition will save the farmer 15 cents to 20 cents per 100 pounds of 6-12-6 used in the substitution.

²Price figures are based upon averages for the area during the 5-year period, 1935-1939.

Source: Results of fertilizer tests conducted over a period of years in the area by the Experiment Station.

Table 13—Long-time average yields of lint cotton per acre with no fertilizer and with given applications of fertilizer, Brown Loam Area¹, 1941

Number of cases	Fertilizer used (lbs.)		Average yield (lbs.)		Increase in yields from fertilizers
	Kind	Average amount	Without fertilizer	With fertilizer	
30	4-8-4	240	157	262	105
19	Nitrate of soda	113	198	262	64

¹Based on estimates of farmers using these fertilizers.

The use of commercial fertilizer for corn is considerably below that for cotton. Of all farmers interviewed in the study, 59 percent reported that in 1941 they used no fertilizer on corn. On an acreage basis about 30 percent of the total was fertilized. Nitrate of soda was the material most widely used. It was used on 61 percent of all acres fertilized, and the average rate of application was 91 pounds per acre. Second in rank by kind of fertilizer used on corn was a 4-8-4 analysis. It was used on 16 percent of the fertilized acres, and the average rate of application was 150 pounds per acre. See table 11. Other fertilizers used on corn consist of various kinds and combinations of materials.

The relatively low use of fertilizer on corn is partly offset through interplanting with summer legumes. Soybeans and cowpeas were interplanted in 46 percent of the corn acreage in 1941. Corn also was planted behind winter legumes on a considerable acreage. The low average yield of 15 bushels of corn per acre indicates that considerably larger amounts of fertilizer could be used to advantage.

The general recommendation by agronomists for fertilizer on corn in the area is 100 to 200 pounds of nitrate of soda or its equivalent per acre. Corn here usually responds favorably to applications up to the larger amount. It responds much less favorably to complete fertilizers, indicating that nitrogen is the limiting element in corn production.

Estimates secured from farmers in the area concur with Experiment Station findings that corn reacts favorably to nitrogenous fertilizers. These estimates indicate an average increase in the normal yield of 7 bushels through the use of 85 pounds of nitrate of soda per acre. See table 14.

Table 14—Long-time average yields of corn per acre with no fertilizer and with given applications of fertilizer, Brown Loam Area¹

Number of cases	Fertilizer used (lbs.)		Average yield (bu.)		Increase in yields from fertilizers
	Kind	Average amount	Without fertilizer	With fertilizer	
39	Nitrate of soda	85	12	19	7
8	4-8-4	150	11	18	7

¹Based on estimates of farmers using these fertilizers.

Feeding Practices and Farm-Grown Feeds

The relation of feeds grown to the numbers of livestock kept on the farms indicates that the feeds produced are far from sufficient to insure good returns from livestock. There is a deficiency of grain produced on many of the farms, but the greatest deficiency is in hays and roughages. There is an abundance of pasture land, which under proper management could support many more livestock. The greater part of the pasture is woodland, however, and provides only a fractional part of its potential carrying capacity. The acreages of hay are insufficient on most of the farms, and on many of the smaller units none is grown. On 39 percent of the one-family size farms studied, no hay was harvested in 1941. This condition was somewhat less striking in the case of the larger units. On the multiple-family size farms studied, the proportion having no hay saved was only 4 percent. The acreages on most of these farms are quite low, however. See table 29. Silage for roughage is almost non-existent in the area. Out of 140 farms surveyed, only 2 or 3 of the larger livestock or dairy farms grew silage in 1941. One reason generally given as to why so little roughage is grown on the smaller farms is that the cost of harvesting equipment is relatively high, considering the smaller use for it. Since three-fourths of the farms fall in the one-family size group, the need is readily seen for studying ways of making harvesting equipment available to farmers at lower costs.

The kinds and quantities of feed recommended by livestock specialists for the different classes of livestock kept are shown in table 15. A comparison of the feeds produced with the needs, based on these recommendations, is shown by types of one-family size farms in table 16.¹

Table 15—Kinds and quantities of feed recommended for livestock in the Brown Loam Area¹

Kinds of animals	Kinds and quantities of feed per head per year		
	Corn (bu.)	Hay (ton)	Pasture ³ (acre)
Work animal	40.5	2.0	2.0
Dairy cow	15.0	2.0	4.0
Beef cow	3.0	.8	4.0
Calves and yearling cattle	.0	.4	2.0
Sow and litter to slaughter ²	112.5	.0	3.0
Sheep and goats	.0	.1	.4
Poultry (1 hen)	1.0	0	0
Household (family of 5)	22.5	0	0

¹In addition to these feeds the following purchased feeds are recommended: 400 lbs. cottonseed meal per dairy cow; 1,750 lbs. mash feed per 40 hens.

²The requirements used for hogs in this study were: corn, 10 bushels, and pasture .5 acre per head raised.

³Includes composite of woodland and open pasture.

Source: Steanson, Oscar and Langsford, E. L.: "Food, Feeds, and Southern Farms," Bureau of Agricultural Economics, Washington, D. C., November, 1939.

¹The comparisons are not shown on multiple-family size farms because the information needed on tenants' livestock and feeds going to them is incomplete.

Table 16—Comparison of farm-grown feeds needed with those produced, one-family size farms, Brown Loam Area, 1941

Kind	Cotton farms ²			Cotton-cattle farms ²			Cotton-dairy ²			Cotton-livestock ²	
	One-mule		Two-mule		One-mule		Two-mule		Two-mule		Two-mule
	Need ³	Produce ³	Need ³	Produce ³	Need ³	Produce ³	Need ³	Produce ³	Need ³	Produce ³	
Corn (bu.)	140.0	131.0	218.0	205.0	169.0	155.0	221.0	169.0	401.0	198.0	356.0
Hay (ton)	5.6	1.3	10.0	4.0	12.8	3.6	14.8	2.4	37.0	8.0	21.6
Pasture (acre) ¹	13.0	26.0	20.0	29.0	46.0	48.0	48.0	45.0	75.0	58.04	47.0
											73.0

¹Includes open and woods pasture.²For a description of farm types see page 24.³To arrive at needed feeds, the requirements in table 15 were applied to the livestock kept on farms of each size and type. To arrive at production, the average yields of corn and hay on all the farms studied, which were: corn, 15 bushels, and hay, 1.2 tons per acre, were applied to the respective acreages. The cropland and livestock organizations for these farms are shown in table 21.⁴This farm has 12 acres of idle cropland that may be used as temporary pasture.

The deficiency in production of grain is slight on all of the one-family size farms classified into the cotton and cotton-cattle systems.¹ On all these farms, except on the two-mule size cotton-cattle farms, the deficiency in corn recommended for livestock feed may be removed by reducing the corn for family use as meal below the amount recommended. The recommendations allow 22.5 bushels of corn for family use, but estimates obtained from farmers show that the average family uses only 12 bushels of corn for meal. By applying the 10.5 bushels difference to livestock feeding, the deficiency is practically offset. To avoid shortages in bad crop years, these farmers should increase their corn acreage slightly. After making this allowance, however, there are deficiencies in corn for livestock feed on all of the two-mule size cotton-cattle, cotton-dairy, and cotton-livestock farms; the deficiencies on these three groups of farms are 42, 192, and 105 bushels, respectively. See table 16. Purchased grain on these farms consumes a high proportion of the farmers' cash incomes.

Hay and roughages produced are greatly deficient on farms of each type organization studied. See table 16. On the cotton farms the needs for hay are about 2½ to 4 times that produced; on the cotton-cattle farms the needs are from 3 to 6 times that produced; and on the cotton-dairy farms the needs are almost 5 times as great as the production. Contrary to what might be expected, the deficiencies in roughages are proportionately higher on the farms keeping the greater numbers of livestock, where the unit cost of production is lower. This indicates that farmers fail to recognize the importance of hays and roughages in the feeding of livestock and do not devote as much of their effort to their production as livestock authorities agree they should. Observations in obtaining farmers' estimates of the kinds and quantities of feed bought give a similar impression, as practically all of the feeds bought are concentrates. Agricultural technicians and leading farmers agree that the quantities of these feeds produced is the limiting factor to a successful expansion of livestock production in the area. These crops are more widely adapted and can be grown more economically than any other crops.

In the case of pasture, practically all of the farms have an acreage sufficient, if properly utilized, to furnish ample grazing for the livestock kept on the farms. But because of the abundance of pasture acreages, few improvement practices are carried out other than the mowing of bitterweeds on the dairy farms; also, about half of the total pasture acreage is in woods. See tables 21 and 29.

Practically all open pasture in the area has a mixture of lespedeza, hop, and white Dutch clovers and grasses, which furnish grazing for a large part of the year. By clearing woods pasture and carrying out other improvement practices, including fertilization and mowing, the carrying capacity of pastures in the area could be increased by a high percentage.

¹For a definition of farm types, see page 24.

Leasing Arrangements

Tenancy is not necessarily an evil to agriculture. Without some system of leasing, it would be impossible to get the land tilled that is necessary to feed, clothe, house, and employ all of the people. It is pointed out by many writers in the field of agriculture that unstable tenure is destructive to farm resources, as well as to the institutions, culture, and well-being of a people.

Tenancy in this area is quite unstable; most of the tenant operators, who are approximately one-third of all farm operators, move every year. Of the tenant operators interviewed in 1941, 88 percent leased their holdings for only 1 year, 2 percent leased for 2 to 3 years, and 8 percent had definite agreements to stay from 3 to 5 years. Also, 80 percent of these leases were oral agreements. The short-term, verbal lease is even more common among the non-operating tenants, including sharecroppers and renters who work under close supervision of an owner-operator. On 44 multiple-family owner-operator farms studied, on each of which there were from 1 to 3 non-operating tenants, every tenant lease was oral and for 1 year.

Table 17—Type and length of lease of tenant operators, Brown Loam Area, Mississippi, 1941

Number studied	Number of oral leases					Number of written leases					Leases including livestock
	Total	One year	2-3 years	3-5 years	Indefinite	Total	One year	2-3 years	3-5 years	Indefinite	
41	33	32	1	0	0	8	4	0	3	1	0
Percentages											
Total cases	Type tenure		Type lease		Duration				Including livestock		
	Share	Cash	Oral	Written	One year	2-3 years	3-5 years	Indefinite			
100	22	78	80	20	88	2	8	2	0		

It is a matter of common observation that tenants who move every year have a marked tendency to "mine the soil" to obtain the greatest immediate return, with little regard to soil conservation and maintenance of farm improvements.

It is difficult for tenants who move nearly every year to keep livestock in sufficient numbers and in such condition as to secure satisfactory returns from them. Another factor which may have a bearing on the lack of livestock kept by tenants is the absence of leasing agreements permitting the farm owner and tenants to share in livestock. No lease providing for the sharing in proceeds from livestock was found on the farms studied. The fact that 78 percent of the tenant operators pay a cash rent may likewise indicate a lack of cooperation and mutual interest between owners and tenants which serves as a barrier against improvements in the tenure system. See table 17. The cash rental system encourages tenants to strive for a higher cash return with less regard to conservation of farm resources, and lessens the owner's interests in the operation of the farm.

Credit Practices

A large part of the farm business of the area is conducted on a

credit basis. Most of the farmers use credit of some kind every year. The types of credit used are grouped under three headings as follows: (1) Short-term credit, which is used to purchase items ordinarily used up within the crop year and which is outstanding for one year or less; (2) intermediate credit, which is used to purchase durable production goods and which is outstanding from one to five years; and (3) mortgage credit which is used for purchasing land, or for refinancing land mortgages, and which is outstanding for five or more years.

Short-term credit was used on 60 percent of the 140 farms surveyed in 1941. On the one-family size farms the average amount used was \$86, of which 48 percent was used to purchase feeds, fertilizers, and other items used in crop production, and 52 percent was used for family living. On the larger farms, most of which are two- and three-family size units, the average amount of short-term credit used was \$147 per farm, of which 58 percent was for family living of the operator and his tenants. Most of this credit is supplied by merchants. The advances are generally outstanding from 5 to 3 months, and the current interest rates are usually 6 to 8 percent. See table 18. A few farmers stated that rates higher than these are charged. In many cases it was impossible to calculate the rates paid, since the amounts paid on interest notes were not known. Also, in some cases it was impossible to determine whether the stated interests were charged for the same period that the debts were outstanding. Most farmers appeared satisfied with credit available to them, but some indicated that interest rates were too high and that the sources supplying short-term credit were uncertain.

Intermediate credit: Only 13 percent of the farms surveyed had outstanding loans of this nature in 1941. Of these, 61 percent were used for buying cattle and the remainder were used for buying workstock. See table 19. One-half of these loans were made by the Farm Security Administration. There are other agencies supplying this type of credit, however, and a great many farmers in the area could improve their situation by taking advantage of it to pay for needed livestock, equipment, and improvements on their farms.

Mortgage credit: Of 99 owner-operated farms surveyed, 44 percent were mortgaged in 1941. See table 20. Most of the mortgages represent security for the unpaid balance of the original purchase price of the farms, although a sizeable portion of them were made for refinancing other mortgages which had become delinquent. The high proportion of farm owners having mortgages in the area may be an after effect of the recent, general business depression. It may, however, be some indication that the agriculture is operating on an unsound financial basis and that farmers are unable to keep their holdings free from debt with the returns received from the farm.

Table 18—Short-term credit: Proportion of farmers using, source, purpose, interest rates, and duration, Brown Loam Area, 1941¹

1941 ¹																				
Total farms	Number using	Source ²					Months duration					Percent interest					Average amount used per family	Percent interest used per family living		
		Mer- chant bank	Local bank	FSA	PCA	Seed loan	Indi- vidual	One-family size farms					10 ³ and over						NA ²	
								5 to	6 to	7 to	8 to	9 to	12	4 to	5 to	6 to				8 to	10^{3} and over	NA^{2}
96	57	25	16	11	1	2	2	17	27	5	8	12	20	13	12	12	\$ 86	52		
Multiple-family size farms																				
44	27	10	9	5	1	1	1	9	14	0	4	5	17	2	3	3	147	58		
Total farms (percentages)																				
100	60	41	30	19	2	4	4	30	49	6	15	20	44	18	18	18	.....	.....		
¹ Short-term credit defined as credit used to purchase items which are used up within the crop year and outstanding for one year or less.																				
² NA, not ascertainable, represents cases where the farmers did not know; FSA is the Farm Security Administration; PCA, the Production Credit Association.																				
..... and interest rates were above 10 percent; one 20, one 25 percent.																				

¹Short-term credit defined as credit used to purchase items which are used up within the crop year and outstanding for one year or less.

²NA, not ascertainable, represents cases where the farmers did not know; FSA is the Farm Security Administration; PCA, the Production Credit Association.

³Only two farmers stated interest rates were above 10 percent; one, 20, one, 25 percent.

Table 19—Intermediate credit: Proportion of farmers using, source, purpose, interest rates, and duration, Brown Loam Area, 1941

duration, Brown Local Area, 1941																		
Total farms using	Mer- chant bank	Source ²			Years duration					Average amount used per family	Purpose		Percent interest					
		Local bank	FSA	PCA	Indi- vidual	1	2	3	5		Indefi- nite	Work- stock	Cows	4	5 to 6	8 to 10	NA ²	
One-family size farms																		
96	16	2	3	7	3	1	5	2	2	6	1	\$229	7	9	5	6	2	3
Multiple-family size farms																		
44	2	2	2	2	2	2	2	2	2	2	2	\$300	2	2	2	2	2	2
Total farms (percentages)																		
140	11	17	50	17	5	11	28	11	11	44	6	39	61	28	44	11	17	17

¹Intermediate credit defined as that used to purchase durable production goods, and outstanding from one to five years.

²NA, not ascertainable, represents cases where the farmers did not know; FSA is the Farm Security Administration; PCA, the Production Credit Association.

Table 20—Mortgage credit: Proportion of farms mortgaged, source of credit and interest rates, Brown Loam Area, 1941¹

Total farms	Number mortgaged	Source ²				Percent interest				
		FLB	Individual	FSA	Local bank	4	5	6	8	NA ¹
One-family size owner-operated farms										
59	27	16	7	2	2	2	8	6	3	8
Multiple-family size owner-operated farms										
40	17	13	3	0	1	2	3	2	1	9
Percentage total owner-operated farms										
100	44	66	23	4	7	9	25	18	9	39

¹Mortgage credit defined as credit used for purchase or refinancing of real estate and outstanding for five or more years.

²NA, not ascertainable, represents cases where the farmers did not know; FSA is the Farm Security Administration; FLB, the Federal Land Bank.

Types of Farm Organization

To compare the efficiency of different types of farm organization in the area, the farm data were collected, analyzed, and averaged by groups of farms, which represent the five different types of farms found there.

These five types of farms are as follows:

1. **Cotton type:** Farms with more than 15 percent of their cropland in cotton and with no other important cash crop or livestock enterprise.

2. **Cotton-cattle type:** Farms having more than 15 percent of their cropland in cotton and having 4 or more cows, with at least 1 cow to each 12 acres of cropland, and selling beef cattle or dairy replacements.

3. **Cotton-dairy type:** Farms having 10 percent or more of their cropland in cotton and having 6 or more cows, with at least 1 cow to each 7 acres of cropland, and selling milk or cream on a commercial scale.

4. **Cotton-livestock type:** Farms having 10 percent or more of their cropland in cotton; and having 5 or more animal units of mature livestock, other than workstock, with at least one animal unit to each 7 acres of cropland, and selling more than one kind of livestock or livestock product on a commercial scale.

5. **Miscellaneous farming type:** Farms not falling in the above classifications.

The farms in each of these types were further classified into one-family size farms and multiple-family size farms. About 50 percent of the farm units in the area fall in the cotton type; 20 percent in the cotton-cattle; 12 percent in the cotton-dairy; 13 percent in the cotton-livestock; and 5 percent in the miscellaneous farming type group.

ONE-FAMILY SIZE FARMS

The one-family size sample farms are grouped for comparative purposes into six principal types of farm organization. See table 21. The most common of these is the one-mule size cotton farm.

These farms usually have from 15 to 20 acres of cropland, a high proportion of which is in cotton. Generally, only a small proportion of the farm land is in crops. The livestock kept generally consists of 2 cows, 3 meat hogs, and about 20 chickens.

The two-mule size cotton farm has an organization much like the one-mule size. The acreage is larger, however, and requires two head of workstock during the breaking and most of the cultivating season. The cropland is usually between 25 and 35 acres and, like the one-mule size cotton farm, it has few livestock.

The one-mule size cotton-cattle farm generally has about 21 acres of cropland. The main difference between the organization of this farm and that of the one-mule cotton farm is in the number of cattle kept. This unit generally has from 6 to 8 head. Also, it has a much greater acreage to pasture than is found on the one-mule cotton farm.

The two-mule cotton-cattle farm is similar to the one-mule size except that the crop acreage is large enough to require two head of workstock. There are generally from 6 to 10 cows on these farms, and the open pasture acreage is nearly as much as that in crops.

The two-mule cotton-dairy farm is generally larger than the other two-mule size farms. The cropland is generally above 30 acres, with a much lower proportion in cotton. Also the pasture acreage is much greater, the open pasture being almost equal to the cropland. The outstanding characteristic of this organization is the number of milk cows kept, which is generally from 12 to 18 head.

The two-mule cotton-livestock farm is generally larger than the two-mule size cotton-dairy farm. The cropland and open pasture acreages are about equal on the two farms. The distinguishing feature of this organization is its combination of livestock enterprises. It generally has two or three maintained for commercial purposes.

Income From Various Farm Organizations

The most significant effect of organization on a farm unit is that reflected in the income which the family receives from it. Analysis of the different types of farms indicates that different combinations of crops and livestock yield varying returns to the families on such units.

Changing price levels affect monetary income to such an extent that for a farm producing the same quantity and quality of products year after year, the income received may be changed very greatly from one year to the next. In an attempt to lessen the effect of war-time inflation on comparative farm incomes and to arrive at conclusions that represent a more nearly "normal" situation, prices in this study for items bought, sold, and used in the home

by farmers were adjusted to the 5-year average, 1935-1939¹ Income calculations hereafter will represent "normalized" income calculated on this basis. The cotton yield on each farm was also adjusted to its average for the last 5 years as given by the AAA.

Net farm income as here calculated is that accruing to the family as a unit rather than that to the head of the household only. The calculations, then, represent the total "normalized" net income produced by the average farm in each size-type group, and permit a comparison of total returns from one type of farm with those from other types.

The "normalized" family incomes produced by each type of one-family size farms are shown in table 21. Cash income represents the returns from sales, increases in livestock inventories, and AAA payments; non-cash income represents the value of home-used products. From gross cash incomes, cash farm expenses are deducted to arrive at net cash income. This is the cash left for family living, and for repairs and replacement of buildings, workstock, and machinery.² From the gross cash and non-cash income the total cash and non-cash farm expenses are deducted to arrive at total net farm income. This figure represents the cash and non-cash returns to the farm for labor, management, and capital. From the total net farm income, interest calculated at 5 percent of the farm investment is deducted to arrive at the cash and non-cash income accruing to the family for labor and management. The resulting figure is called family labor earnings.

The incomes from farm organizations of the most numerous types are comparatively low. For the one-mule size cotton farm the "normalized" net cash income accruing to the family is \$165. See table 21. This comes very largely from the sale of crops. The non-cash income is \$190. The total net income, or return to labor, management, and capital, is \$324; and the family earnings are \$254.

On the two-mule size cotton farm, which has approximately the same total acreage as the one-mule cotton farm, the net cash income is \$295 and the family labor earnings are \$367, as compared to \$165 and \$254, respectively, for the one-mule size farm. The difference in the incomes is due mainly to the difference in acreage of cropland.

On the one-mule size cotton-cattle farm the cropland is very little more than that on the one-mule cotton farm, but it has considerably more pasture and has five head more of cattle. The net cash income is \$255, and the family labor earnings are \$337 for the cotton-cattle farm, as compared to \$165 and \$254, respectively, for the similar size cotton farm. Here the difference in incomes is due largely to the difference in the numbers of cattle kept.

¹The prices used were obtained from the Agricultural Marketing Service for the crop reporting districts in the Brown Loam Area and are shown in Appendix tables 2 and 3.

²The charges for depreciation on buildings, workstock, and machinery are treated as non-cash farm expense, and the uniform rates which were applied to farmers' estimated values of these items are shown in Appendix table 4.

Table 21.—Farm organization and incomes by types of one-family size farms, Brown Loam Area, 1941

Item	Size and type of farm						
	Cotton		Cotton-cattle		Cotton-dairy		Cotton-livestock
	One-mule \$ 1393	Two-mule \$ 2089	One-mule \$ 1659	Two-mule \$ 2027	Two-mule \$ 3294	Two-mule	
Total investment							\$ 3142
Acres in farm:	76.3	76.9	93.8	96.4	121.9		132.7
Cropland	18.9	30.0	21.1	24.8	39.3		38.4
Open pasture	11.1	15.3	17.9	20.0	21.5		27.5
Woods pasture	14.4	16.3	29.8	23.5	34.5		45.3
Woods not pastured	30.2	7.2	22.6	22.6	23.4		15.6
Other land	1.7	8.1	2.4	5.5	3.2		5.9
Cropland organization (acre):							
Cotton	4.5	7.4	3.6	6.1	3.7		7.4
Corn	8.8	14.3	10.3	11.6	13.2		15.4
Oats and lespedeza	0	0	0	0	1.8		.2
Silage	0	0	0	0	0		.3
Hay crops	1.4	2.9	3.1	3.0	6.5		6.3
Summer legumes turned under	1.3	1.0	.8	.9	.6		4.9
Garden and truck	1.0	.9	.5	.3	1.2		1.3
Sorghum for syrup	.3	.4	0	.3	.3		.4
Sweetpotatoes	.3	.5	.3	.4	.4		.5
Idle cropland	1.3	2.6	2.5	1.6	11.6		1.7
Livestock organization:							
Workstock	1	2	1	2	2		2
Cows	2	3	7	8	15		8
Sows	0	1	1	1	0		2
Meat hogs	3	3	2	3	3		4
Chickens	19	29	31	31	43		72

Table 21—(continued)—Farm organization and incomes by types of one-family size farms, Brown Loam Area, 1941¹

Item	Size and type of farm					
	Cotton		Cotton-cattle		Cotton-dairy	Cotton-livestock
Total investment	One-mule	Two-mule	One-mule	Two-mule	Two-mule	Two-mule
	\$1393	\$2089	\$1659	\$2027	\$3294	\$3142
Cash income:						
Crop receipts ²	\$ 194	\$ 320	\$ 180	\$ 262	\$ 247	\$ 380
Livestock receipts	48	82	166	159	911	416
Gross cash income	242	402	346	421	1158	796
Non-cash income						
Crops, garden, and wood	112	117	98	111	116	129
Livestock and livestock products	78	108	105	123	124	149
Total non-cash income	190	225	203	234	240	278
Total gross income	432	627	549	655	1398	1074
Expenses:						
Cash farm expenses	77	107	91	118	558	257
Non-cash farm expenses	31	49	38	52	62	72
Total farm expenses	108	156	129	170	620	329
Net cash income (gross cash income less cash expenses)	165	295	255	303	600	539
Total net income (total income less total expenses)	324	471	420	485	778	745
Interest on investment	70	104	83	101	165	157
Family labor earnings	254	367	337	384	613	588

¹Income calculations based on average of prices paid and received by farmers in the area during the 5-year period, 1935-1939.

²Includes AAA payments made to the farms for the 1941 crop year.

On the two-mule size cotton-cattle farm the net cash income is \$303 and the family labor earnings, \$384. The corresponding figures for the two-mule cotton farm are \$295 and \$367. The cotton-cattle farm has 5 acres less cropland, but it has five head more of cattle than the cotton farm. Increasing the cropland acreage or the number of cattle increases the income correspondingly.

For the two-mule cotton-dairy farm the net cash income is \$600 and the family labor earnings are \$613, as compared to \$295 and \$367, respectively, for the two-mule cotton farm. This difference in income is accounted for by the fact that the cotton-dairy farm has 12 head more of milk cows and 9 acres more of cropland than the cotton farm.

On the two-mule size cotton-livestock farm, the net cash income is \$539 and the family labor earnings are \$588, as compared to \$295 and \$367, respectively, for the two-mule cotton farm. The difference in incomes of the two farms is attributable to the differences in numbers of cattle and hogs and the difference in crop acreage on the two farms.

The average farm investments of the types of farms studied ranged from \$1,393 for the one-mule size cotton farm to \$3,294 for the two-mule cotton-dairy farm. A comparison of the investments to the incomes by types of farms, reveals that in nearly every case the farm types yielding the greatest returns likewise have larger investments. See table 21. The additional investments required are, no doubt, a factor in preventing farmers from making adjustments on their farms which would increase their incomes. To farmers who have managed to make these additional investments, however, there has been a substantial increase in the cash returns over those to farmers having smaller investments. There are numerous poorly organized farms, both large and small, in the area which offer the opportunity for increased returns through more efficient operation.

Relation of Farm Incomes to Employment

The outstanding weakness of the small one-cash-enterprise farm, which is reflected through the extremely low income produced, is in its inability to provide year-round employment for the resident labor force. Although a comparatively good return per day worked may be obtained from such a farm, the total days of labor provided are inadequate to produce a good annual income. The type of farm producing the greatest number of days employment for the year likewise yields the highest farm income, although the highest return per day was obtained on the farm requiring the least number of days worked. See table 22.

The problem of providing the maximum days of employment on a farm involves the combination of enterprises as well as the size of business. All crops have periods of "peak" labor requirements, while at other times of the year, they require but little labor. Unless there is a dependable supply of labor which may be hired at

Table 22—Days worked and available days of labor by months, family labor earnings and returns per day worked by farm types, one-family size farms, Brown Loam Area, 1941

Types of farm organizations	Man equivalent days worked and available days labor ^{1,2}												Family ³ labor earnings	Returns per day worked
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
One-mule cotton available	24	24	34	34	38	35	33	37	38	39	34	22	392	\$1.74
One-mule cotton worked	3	5	12	15	20	21	9	11	20	20	7	3	146	
Two-mule cotton available	25	25	35	35	39	36	34	38	39	40	35	23	404	\$1.65
Two-mule cotton worked	4	7	18	22	30	33	13	16	32	32	11	4	222	
One-mule cotton-cattle available	22	22	32	32	35	32	31	34	35	36	32	30	363	\$2.36
One-mule cotton-cattle worked	5	6	13	14	19	21	8	10	17	18	8	4	143	
Two-mule cotton-cattle available	27	27	39	39	43	40	38	42	43	45	39	25	447	\$2.02
Two-mule cotton-cattle worked	5	7	16	19	25	27	11	14	26	27	9	4	190	
Two-mule cotton-dairy available	20	20	28	28	32	39	28	31	32	33	28	18	327	\$1.81
Two-mule cotton-dairy worked	18	20	30	32	38	40	23	29	34	35	23	17	339	
Two-mule cotton-livestock available	29	29	40	40	45	42	39	44	45	46	40	26	465	\$2.19
Two-mule cotton-livestock worked	7	11	22	26	37	37	15	25	34	35	13	7	269	

¹Labor requirements based on enterprise records secured in area; shown for separate enterprises in Appendix, table 1.

²Estimated working days per year in the area are 197; man equivalents of available labor are calculated as follows: males, 18 years or older=1.0; 10 to 18 years=.6; females, 10 years and up=.3.

³Income calculations based on average prices paid and received by farmers in the area, 1935-1939.

wage rates the farmer can afford to pay during these "peak" seasons, the acreage of a crop or combinations of crops which a given labor force can care for throughout the year is determined by the acreage it can handle during these "peak" seasons. For cotton and the combinations of enterprises usually found on cotton farms, the "peak" seasons occur at chopping time in May and June and at harvesting time in September and October.

The labor requirements for the two-mule cotton farm are: in June, 33 man-equivalent days, and in September and October, each 32 man-days. The available labor on this farm for June is 36 man-equivalent days, and for September, 39 man-equivalent days. See table 22. The labor force is employed near full-time during these months; yet, for the entire year, the labor required for the farm is 222 man-equivalent days as compared with 404 that are available. In this case the labor force is unemployed 45 percent of its available time, and receives a family labor earning of only \$367. There is clearly a need for providing more employment on this farm and a better income for the family. With the present organization, however, it is impossible to considerably increase the total days of employment materially without increasing the requirements beyond the available labor supply during the "peak" seasons. Livestock enterprises aid materially in making the needed adjustments.

The two-mule cotton-dairy farm presents a good example of the effect of organization on total labor provided and its distribution throughout the year, as well as on the income derived from the farm. The labor requirements are 339 man-equivalent days as compared with 222 days for the two-mule cotton farm. See table 22. The family labor earnings amount to \$613 as compared to \$367 and the net cash income is \$600 as compared to \$295, for the cotton farm. The labor requirements on the dairy farm exceed the available supply by 15 days during 6 months. During the other 6 months, the labor force exceeds the requirements by only 10 days. This type of farm organization provides year-round employment for the labor force without seriously increasing the "labor load" during the "peak" seasons and also yields a very desirable income when compared with the income from other types of organizations.

Need for Farm Adjustments and Kinds Suggested

In addition to under employment, another factor which contributes to the low income is the failure of the operators to fully utilize the available natural resources of their farms. Many of the lowest income-producing farms in the area have as much land suited for cropland and open pasture as is used by the units which produce the higher incomes. Some of them have enough fenced open pasture land to carry many more livestock than are now kept, and on most of them there is usually a large proportion of the land in woods or unfenced open land.

An attempt is made in the following discussion to point out some factors responsible for differences in incomes produced by different farms, and to suggest possible adjustments in farm or-

ganization that may increase the returns from the less efficient units.

The method followed in determining the suggested adjustments employs the principle of adapting the systems and practices being followed by the more successful farmers in the area to the farms on which the operators have been less successful. The adjustments are based upon results secured by the type of unit into which the farm considered is transformed. This approach is predicated upon the idea that what some farmers have proved to be good farming practices for themselves are likewise good for others. Although there may be some practices followed on the better farms which could be profitably improved upon, the success attained by farmers on these units sets a desirable goal for others.

An analysis of the sample farm records indicates that over a period of years cotton yields a higher cash return per unit of labor and of capital investment than any other enterprise found on these farms. But, because of the relatively high labor requirements of cotton during chopping and picking seasons, the acreage a family can handle is too small to yield a good income. Cotton acreage has been restricted by the AAA program. Cotton as a cash enterprise is given full consideration in arriving at the alternative farm organizations here suggested. The other enterprises are considered as supplementary to and not as substitutes for the cotton enterprise.

There are two principal types of adjustments which may be made to increase days of employment and to facilitate full utilization of resources on the farms. One of these is to increase the size of the present organization; the other is to make adjustments in the combination of crop and livestock enterprises so as to distribute labor requirements throughout the year. These two types of adjustments will now be applied in turn to the low income farms in each size type group.

Farm Income Changes With Adjustments in Organization

In adjusting the organization of the cotton farms to conform to that of the cotton-cattle and cotton-dairy farms, the cattle are increased to the number which the farm has the physical capacity to support. The acreages of pasture and of feed crops are adjusted to give the same proportions of these nutrients per unit of livestock as are found on the cotton-cattle and cotton-dairy farms, respectively. The cash expenses are also adjusted to allow the same amount for purchased feeds per unit of livestock as is used on these farms. Other cash expenses, such as building repairs and hauling costs for milk are likewise adjusted in line with the other farms. In determination of the income from these reorganizations, the crop receipts remain the same, since the acreage of cash crops is not changed. The income from livestock is adjusted to allow the same returns per cow as those received on each of the other type organizations.

One-Mule Size Farms

Adjusting the organization of the one-mule cotton farm to con-

Table 23—Changes in farm incomes due to adjustments in organization, one-family size farms, Brown Loam Area, 1941¹

Total investment	Present organization	Alternative organizations	
	One-mule cotton	One-mule cotton-cattle	One-mule cotton-dairy
	\$13.93	\$1593	\$1738
Acres in farm:	76.3	76.3	76.3
Cropland	18.9	18.9	18.9
Open pasture	11.1	17.5	11.1
Woods pasture	14.4	20.3	14.4
Woods not pastured	30.2	17.9	30.2
Other land	1.7	1.7	1.7
Cropland organization:			
Cotton	4.5	4.5	4.5
Corn	8.8	8.8	8.2
Oats and lespedeza	0	0	.8
Hay crops	1.4	2.7	2.7
Summer legumes turned under	1.3	0	0
Garden and truck	1.0	1.0	1.0
Sorghum for syrup	.3	.3	.3
Sweetpotatoes	.3	.3	.3
Rotation pasture	0	0	0
Idle cropland	1.3	1.1	1.1
Livestock organization:			
Workstock	1	1	1
Cows	2	7	6
Sows	0	0	0
Meat hogs	3	3	3
Chickens	19	19	19
Cash income:			
Crop receipts ²	194	194	194
Livestock receipts	48	125	370
Gross cash income	242	319	564
Non-cash income:			
Crops, garden, and wood	112	112	112
Livestock and livestock products	78	114	110
Total non-cash income	190	226	222
Total gross income	432	545	786
Expenses:			
Cash farm expenses	77	78	253
Non-cash farm expenses	31	33	34
Total farm expenses	108	111	287
Net cash income			
(gross income less cash for farm expenses)	165	241	311
Total net income (total income less total expenses)	324	434	499
Interest on investment	70	80	87
Family labor earnings	254	354	412

¹Income calculations based on average prices paid and received by farmers in the area during the 5-year period, 1935-1939.

²Includes AAA payments made to the farms for the 1941 crop year.

form to that of the one-mule cotton-cattle farm, and in increasing the cattle from 2 to 7 head, increases the net cash income from \$165 to \$241, or 46 percent, and increases the family labor earnings from \$254 to \$354, or 39.4 percent. See table 23. To accomplish this adjustment, an increase of \$200 in the farm investment is required. This includes the purchase price of the additional cattle and the

additional cattle housing and fencing. The increased cash returns will equal the additional investment in 3 years, and the increased cash and non-cash returns will equal it in 2 years. There is required also an increase of 6.4 acres of open pastures, and fencing for a total of 12 additional acres. The open pasture will have to come from clearing of woodland, but reference to table 25 shows that according to the farmers' estimates, there are 34 acres of woodland which, if cleared, would be as good as the present open pasture, 17 acres of which would be as good as the present cropland. No increase is required in the total cropland, but the hay is increased by 1.3 acres. This is obtained by saving the hay from 1.3 acres on which the hay has heretofore been left on the ground for pay as summer legumes under the AAA program. The increased barnyard fertilizer from the additional cows will more than offset the soil fertility lost from the green manure crop.

In effecting the shift from the one-mule cotton to the one-mule cotton-dairy type organization, and increasing the cattle from two ordinary farm cows to six dairy cows, the net cash income is increased from \$165 to \$311, or 88.5 percent, and the family labor earnings are increased from \$254 to \$412, or 62.2 percent. See table 23. This adjustment requires an additional investment of \$345 for the purchase price of the additional cattle and the additional cattle housing required. The increased cash returns equal the increased investment in about two and one-half years. The adjustment requires no additional cropland or pasture. It does, however, require a different combination of feed crops to give .8 acre of oats followed by lespedeza, and 1.3 acres more of hay. The additional hay and oat acreage is obtained by reducing the corn acreage to the requirements of the dairy farm and by saving the hay from 1.3 acres on which the hay has been heretofore left on the ground as summer legumes. The loss in soil fertility due to the saving of summer legumes for hay will be offset by barnyard manure from four additional cows.

Two-Mule Size Farms

Adjusting the organization of the two-mule size cotton farm to conform to that of the cotton-cattle farm of similar size increases the net cash income of the farm from \$295 to \$358, or 21.4 percent, and increases the family labor earnings from \$367 to \$438, or 19.3 percent. See table 24. The adjustment requires an increase of \$115 in the farm investment for purchasing additional cattle, and for additional fencing and cattle housing. The increase in net cash returns will pay for the increase in investment in 2 years. An increase of 2.2 acres of open pasture land is required for carrying the increased cattle, but the required cropland may be reduced by the same figure and still meet the requirements of the cotton-cattle farm. It is necessary to retain the same cropland base in order that the cotton allotment may not be reduced. These conditions may be met by utilizing the 2.2 acres as rotation pasture, which is considered cropland under the AAA program. An increase of 4 acres is required in the woods pastured, but, according to farmers' estimates shown in

Table 24—Changes in farm incomes due to adjustments in organization, one-family size farms, Brown Loam Area, 1941¹

Item	Present organization	Alternative organizations	
	Two-mule cotton	Two-mule cotton-cattle	Two-mule cotton-dairy
Total investment	\$2089	\$2204	\$2700
Acres in farm	76.9	76.9	76.9
Cropland	30.0	30.0	30.0
Open pasture	15.3	15.3	15.3
Woods pasture	16.3	20.3	16.3
Woods not pastured	7.2	3.2	7.2
Other land	8.1	8.1	8.1
Cropland organization (acres):			
Cotton	7.4	7.4	7.4
Corn	14.3	13.0	13.1
Oats and lespedeza	0	0	1.2
Hay crops	2.9	2.8	4.3
Summer legumes turned under	1.0	0	0
Garden and truck	.9	.9	.9
Sorghum for syrup	.4	.4	.4
Sweetpotatoes	.5	.5	.5
Rotation pasture	0	2.4	0
Idle cropland	2.6	2.6	2.2
Livestock organization:			
Workstock	2	2	2
Cows	3	7	10
Sows	1	1	1
Meat hogs	3	3	3
Chickens	29	29	29
Cash income			
Crop receipts ²	\$ 320	\$ 320	\$ 320
Livestock gross cash income	82	149	630
Gross cash income	402	469	950
Non-cash income:			
Crops, garden, and wood	117	117	117
Livestock and livestock products	108	125	115
Total non-cash income	225	242	232
Total gross income	627	711	1182
Expenses:			
Cash farm expenses	107	111	404
Non-cash farm expenses	49	50	58
Total farm expenses	156	161	462
Net cash income (gross cash income less cash farm expenses)	295	358	546
Total net income (total income less total expenses)	471	550	720
Interest on investment	104	112	135
Family labor earnings	367	438	585

¹Income calculations based on average prices paid and received by farmers in the area during the 5-year period, 1935-1939.

²Includes AAA payments made to the farm for the 1941 crop year.

table 25, there are 7.2 acres of unpastured woods on the farm that may be fenced and used as pasture.

Shifting the organization of the two-mule cotton farm to conform to that of the two-mule cotton-dairy farm and increasing the cattle from 3 ordinary farm cattle to 10 dairy cows increases the net cash income from \$295 to \$546, or 85.1 percent, and increases the family labor earnings from \$367 to \$585, or 59.4 percent. See table 24. The

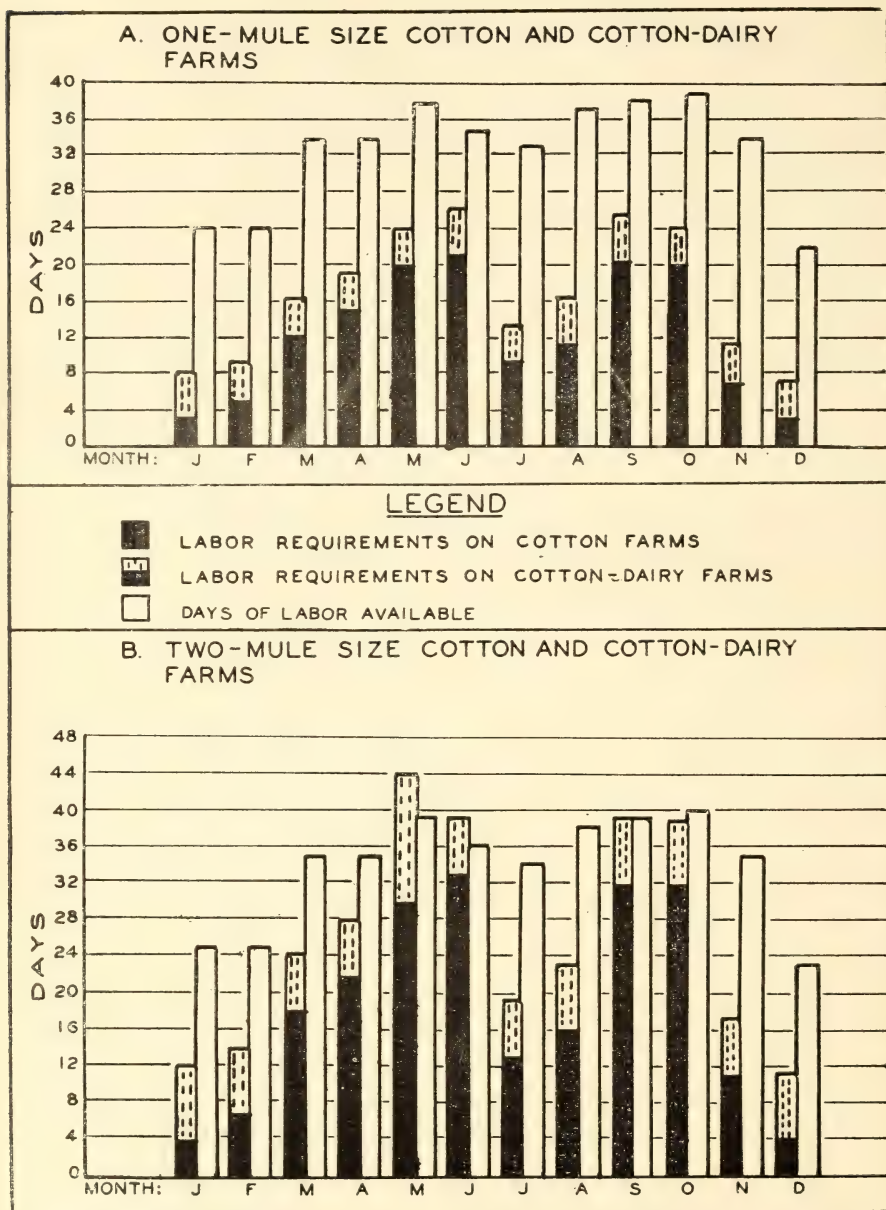


Figure 2. Monthly labor requirements as related to available man-equivalent days of work for resident labor forces, on cotton and cotton-dairy farms, Brown Loam Area, 1941

reorganization requires an increase of \$611 in investment, which covers the purchase price of the additional cattle and the cost of additional cattle housing. The increased net cash returns will equal the increased investment in about two and one-half years. No increase in cropland or pasture is required. The hay crops are increased by 1.4 acres plus 1.2 acres seeded to oats and lespedeza. Part of this acreage is obtained by a reduction in corn of 1.2 acres and a reduction in idle cropland of .4 acre. The other hay will come from an acre on which the hay has heretofore been left as summer legumes, the soil fertility lost being offset by the manure obtained from seven head of additional cattle.

Changes in Farm Employment Through Adjustments in Organization

As previously stated, one of the main faults with the one-cash enterprise type farm, which is reflected in low farm income, is the failure of the organization to provide full year-round employment for the resident labor force. Labor is the most important cost item of a farm business, and any adjustment which increases the efficiency of its use or causes it to be employed a greater part of the time is accompanied by an increase in farm income.

Adjusting the organization of the one-mule size cotton farm to conform to that of the cotton-dairy farm of similar size increases the labor requirements from 146 to 198 man-equivalent days, or 35.6 percent. The adjustment increases the net cash income from \$165 to \$311, or 88.5 percent. See table 23.

Adjusting the organization of the two-mule size cotton farm to conform to that of the cotton-dairy farm of similar size increases the labor requirements from 222 to 309 man-equivalent days, or 39.2 percent. The adjustment increases the net cash income from \$295 to \$546, or 85.1 percent. See table 24. The results of these adjustments on labor requirements are shown graphically in figure 2. By the adjustments the labor requirements are increased throughout the year and are increased proportionately more during the "slack" season than during the "peak" labor seasons. This is very desirable, because it allows for a greater increase of farm employment without seriously exceeding the available labor during the rush seasons.

Farm Income Changes With Variations in Size of Business

The other principal factor which affects labor requirements and farm income is the size of farm business. Because of the high ratio of people to the land in this area, few farms can be increased in total acreage, but the size of farm business can be increased on many of the farms through a more intensive use of available land. Not all woodland or open fallow land on the farms is suited for cropland or pasture. It is, therefore, not intended as a general recommendation that all farmers having woodland should clear and convert it to more intensive use. Land that is too steep and rugged should be left in woods and stands of timber improved as needed.

Table 25—Present and potential land use, one-family size farms, Brown Loam Area, 1941¹

Use class	Size and type of farm					
	One-mule cotton acres	Two-mule cotton acres	One-mule cotton-cattle acres	Two-mule cotton-cattle acres	Two-mule cotton-dairy acres	Two-mule cotton livestock acres
Present land use						
Cropland	18.9	30.0	21.1	24.8	39.3	38.4
Woods pastured	11.1	15.3	17.9	20.0	21.5	27.5
Woods not pastured	14.4	16.3	29.8	23.5	34.5	45.3
Other land	30.2	7.2	22.6	22.6	23.4	15.6
	1.7	8.1	2.4	5.5	3.2	5.9
Total	76.3	76.9	93.8	96.4	121.9	132.7
Potential land use converting suitable pasture land to crops and fencing woodland						
Cropland	27.4	43.5	34.0	42.3	52.1	62.1
Open pasture	2.6	3.8	5.0	9.9	8.7	3.8
Woods pastured	44.6	21.5	52.4	38.7	57.9	60.9
Woods not pastured	0	0	0	0	0	0
Other land	1.7	8.1	2.4	5.5	3.2	5.9
Total	76.3	76.9	93.8	96.4	121.9	132.7
Potential land use; clearing and converting suitable land to crops and open pasture						
Cropland	44.5	61.0	64.1	71.4	76.5	96.4
Open pasture	19.8	4.4	5.0	12.5	8.7	3.8
Woods pastured	10.3	3.4	22.3	7.0	33.5	26.6
Woods not pastured	0	0	0	0	0	0
Other land	1.7	8.1	2.4	5.5	3.2	5.9
Total	76.3	76.9	93.8	96.4	121.9	132.7

¹Based on farmers' estimates of land capabilities.

The illustrations are, however, made to point out some evils of the undersized farm, to discourage the buying of farms which are too small to support a family, and for the benefit of those having additional land suited for more intensive use in adjusting their organizations to obtain a better return from their farms. The recommendations for clearing woodland for more intensive use are based upon the estimates of the operators of the farms studied as to the suitability of their woodland for crops and pasture uses. These farmers were asked to state the proportions of their open pasture land which would be as good for crops as their present cropland, and the proportions of woodland, which, if cleared, would be as good as their present open pasture, and the proportions that would be as good for crops as their present cropland.

The one-mule size cotton farm has 18.9 acres of cropland, 11.1 acres of open pasture, and 14.4 acres of woods pasture. Clearing and shifting suitable land into more intensive use increases the farm size to 44.5 acres of cropland, 19.8 acres of open pasture, and leaves 10.3 acres of woods which may be pastured. See table 25. The farm can be increased to the size of the two-mule cotton farm by clearing 15.3 acres of the 34.3 acres of suitable woodland and fencing 6.1 acres of this for pasture. The net farm income due to the adjustment would be increased from \$165 to \$295, or 78.8 percent, and the family labor earnings would be increased from \$254 to \$367, or 44.5 percent. See table 26.

The one-mule size cotton-cattle farm has 21.1 acres of cropland, 17.9 acres of open pasture, and 29.8 acres of woods pasture. Clearing and shifting suitable woodland to pasture and cropland increases this farm to 64.1 acres of cropland, 5 acres of open pasture, with 22.3 acres of woods left which may be pastured. See table 25. It can be increased to the size of the two-mule cotton-cattle farm by clearing 5.8 of 30.1 acres of suitable woodland and by adding one cow and one head of workstock. This adjustment would increase the net farm income from \$255 to \$303, or 18.8 percent, and would increase the family labor earnings from \$337 to \$384, or 13.9 percent. See table 26. It can also be increased to the size of the two-mule cotton-cattle farm reorganized from the cotton farm of similar size by clearing 11.8 of the 30.1 acres of suitable woodland and increasing the cattle by 2 head and the workstock by 1 head. This would increase the net farm income from \$255 to \$371, or 45.5 percent, and increase the family labor earnings from \$337 to \$450, or 33.5 percent. See table 26.

The present two-mule size cotton-cattle farm can be increased to the suggested two-mule size cotton-cattle farm by clearing 6 out of 39.1 acres of suitable woodland and fencing 3.4 acres of this for pasture and increasing the cattle by 1 head. This adjustment would increase the net cash income from \$303 to \$371, or 22.4 percent, and increase the family labor earnings from \$384 to \$450, or 17.2 percent. See table 26.

A comparison of the incomes produced by the three sizes of

Table 26—Changes in farm incomes with variations in size of business, one-family size farms, Brown Loam Area, 1941

Item	Cotton farms		Cotton-cattle farms			Cotton-dairy farms		
	A1	B1	C1	D1	E2	F3	G4	H1
	Present one-mule size	Present two-mule size	Present one-mule size	Present two-mule size	Suggested two-mule size	Suggested one-mule size	Suggested two-mule size	Present two-mule size
Land use:								
Acres in farm	76.3	76.9	93.8	96.4	96.4	76.3	76.9	121.9
Cropland	18.9	30.0	21.1	24.8	30.0	18.9	30.0	39.3
Open pasture	11.1	15.3	17.9	20.0	20.8	11.1	14.3	21.5
Woods pastured	14.4	16.3	29.8	23.5	26.1	14.4	18.0	34.5
Woods not pastured	30.2	7.2	22.6	22.6	14.0	30.2	6.5	23.4
Other land	1.7	8.1	2.4	5.5	5.5	1.7	8.1	3.2
Livestock organization:								
Workstock	1	2	1	2	2	1	2	2
Cows	2	3	7	8	9	6	10	15
Hogs	3	4	3	4	4	3	4	3
Chickens	19	29	31	31	31	19	29	43
Net cash income	\$165	\$295	\$255	\$303	\$371	\$311	\$546	\$600
Family labor earnings	\$254	\$367	\$337	\$384	\$450	\$412	\$585	\$613

iColumns A, B, C, D, and H represent the present organization of the indicated type farms; these organizations are shown in detail in table 21.

2Column E represents a suggested reorganization of the two-mule size cotton farm shown in Column B; complete organization and breakdown of income shown in table 24.

3Column F represents a suggested reorganization of the one-mule size cotton farm shown in Column F; complete organization and breakdown of income shown in table 23.

4Column G represents a suggested reorganization of the two-mule size cotton farm shown in Column B; complete organization and income breakdown shown in table 24.

cotton-dairy farms shown in table 26 illustrates well the effect that \$311 for the suggested one-mule size farms, \$546 for the suggested two-mule size, and \$600 for the present two-mule size farms.¹ The suggested one-mule size farm can be increased to meet the physical capacity of the suggested two-mule size by clearing 14.3 of 34.3 acres of suitable woodland. See table 25. Of the land cleared, 3.2 acres plus 3.6 acres of additional woods pasture would have to be fenced. The milk cows would be increased from 6 to 10 head. The shift would result in an increase of \$235, or 75.5 percent, in the net cash income.

Neither the one-mule nor the two-mule size cotton-dairy farm derived from the cotton farms of similar sizes can be increased to meet the physical requirements of the present two-mule size cotton-dairy farm. The organization as shown for these farms in table 26 represents the most efficient combination of field crop and livestock enterprises which these units have the capacity to support.

Changes in Farm Employment with Variations in Size of Business

It was pointed out earlier that any adjustment in farm organization which results in increased farm income is accompanied by an increase in farm employment. It is shown in the following discussion that as farm income is increased through an increase in the size of business, farm employment is likewise increased. It may be stated, in general, that any of the suggested adjustments which increase farm employment likewise increase the farm income.

The labor requirements for the one-mule size cotton farm are 146 man-equivalent days. The family labor earnings are \$254. On the two-mule size cotton farm where there are 11.1 acres more of cropland, the labor requirements are 222 man-equivalent days and the family labor earnings are \$367. See table 27. The labor requirements are 52 percent higher on the larger farm, and the family labor earnings are 44.5 percent higher.

The labor requirements on the one-mule size cotton-cattle farm are 143 man-equivalent days, and the family labor earnings are \$337. As the size of farm is increased to that of the present two-mule cotton-cattle farm, the labor requirements are increased to 190 man-equivalent days, or 32.9 percent, and the family labor earnings are increased to \$384, or 13.9 percent. See table 27. As the size of the present two-mule cotton-cattle farm is increased to that of the suggested two-mule cotton-cattle farm, which is derived from the present two-mule cotton farm, the labor requirements are increased to 213 man-equivalent days, or 12.1 percent, and the family labor earnings are increased to \$450, or 17.2 percent.

The labor requirements for the suggested one-mule size cotton dairy farm which is derived from the present one-mule size cotton

¹The organization of the suggested one- and two-mule cotton-dairy farms was derived from the original cotton farms of corresponding sizes. The present two-mule size cotton-dairy is the original two-mule cotton-dairy farm. The expansion possibilities of these farms are shown for the original organizations, which are of the same sizes, in table 25.

**Table 27—Changes in farm employment with variations in size of business,
one-family size farms, Brown Loam Area, 1941**

Size and type farm	Man-equivalent days labor required												Family labor earnings ¹
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Cotton farms													
One-mule size	3	5	12	15	20	21	9	11	20	20	7	3	146
Two-mule size	4	7	18	22	30	33	16	13	32	32	11	4	222
													\$254
													367
Cotton-cattle farms													
One-mule size	5	6	13	14	19	21	8	10	17	18	8	4	143
Two-mule size	5	7	16	19	25	27	11	14	26	27	9	4	190
Suggested two-mule size ²	5	6	17	21	29	32	12	15	31	31	10	4	213
													337
													384
													450
Cotton-dairy farms													
Suggested one-mule size ²	8	9	16	19	24	26	13	16	25	24	11	7	198
Suggested two-mule size ²	12	14	24	28	44	39	19	23	39	39	17	11	309
Present two-mule size	18	20	30	32	38	40	23	29	34	35	23	17	339
													412
													585
													613

¹Represents net cash income and value of home-used products accruing to the family after paying all costs and deducting interest on investments.

²Represents a suggested reorganization of the present cotton farm of similar size.

farm, are 198 man-equivalent days, and the family labor earnings are \$412. See table 27. As the size of the farm is increased to that of the suggested two-mule cotton-dairy farm, derived from the two-mule cotton farm, the labor requirements are increased to 309 man-equivalent days, or 56.1 percent, and the family labor earnings are increased to \$585, or 42 percent. As the suggested two-mule size cotton-dairy farm is increased in size to that of the present two-mule cotton-dairy farm, the labor requirements are increased to 339 man-equivalent days, or 9.7 percent, and the family labor earnings are increased to \$613, or 4.8 percent.

It has been shown that in every case where the farm income is increased through an increase in the size of business, labor requirements are likewise increased. An increase in the size of business does not affect the distribution of labor requirements throughout the year, however, but increases it proportionately throughout the year. See table 27. The monthly distribution of labor requirements is determined largely by the combination of enterprises included in the farm organization.

MULTIPLE-FAMILY SIZE FARMS

The deficiencies pointed out and the adjustments suggested for the one-family size farms are applicable in most cases to the corresponding types of organization found on the multiple-family size farms. Since the principles involved in arriving at possible adjustments for the multiple-family size farms are the same as those used in connection with the one-family size farms, the methods used are not repeated in detail here.

The types of farms found in the multiple-family size group are the same as those in the one-family size group, except that there is no type classified as cotton-dairy. Some of the cotton-livestock farms have dairy enterprises of considerable size, but they also have one or more other livestock enterprises of considerable importance. The livestock enterprises on the larger farms are carried on entirely by the operator. No case of sharing in livestock between the operator or non-operating owner and his tenants was found. The livestock enterprises on the larger farms represent not what a farm can support, but that which the operator and his family, with perhaps a few days of hired labor, can take care of.

The average two-family size cotton farm has 158 acres of farm land, of which 72.4 acres, or 45.8 percent, is woodland. The resident labor force is capable of supplying 494 man-equivalent days work per year, of which 54 percent is employed. See table 28. After paying all farm costs, the cash income accruing to labor and capital is \$267, the operator's share of which is \$157.¹ See table 29.

¹The value of farm-used products is not available for tenants on the multiple-family units, since only the farm operator was interviewed and this information could not be obtained from him. To facilitate comparison of farm units, the values of these products are omitted for the operators, and only cash returns are shown.

Table 28—Man-days of labor required and days of labor available, multiple-family size farms, Brown Loam Area, 1941

Size and type of farm	Man-equivalent days required ¹												Available man-equivalent days ²	Percent available labor employed	
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.			Total
Two-family cotton	4	7	20	26	38	40	14	22	40	39	12	3	265	494	53.6
Two-family cotton-cattle	6	11	26	33	50	52	19	30	53	52	14	5	351	652	53.8
Three-family cotton	7	15	57	73	109	118	38	56	117	114	29	5	738	1,363	54.2
Three-family cotton-cattle	9	17	47	61	91	99	33	53	103	100	28	8	652	1,244	52.4
Two-and three-family cotton-livestock	10	24	54	55	86	94	25	67	64	70	30	8	587	731	80.3

¹Labor requirements based on enterprise records secured in area and shown for separate enterprises in Appendix, table 1.

²Estimated working days per year in the area are 197; man equivalent days of available labor are calculated as follows: males, 18 years or older = 1.0; 10 to 18 years = .6; females, 10 years and up = .3.

The corresponding income to the one-family cotton farm of 77 total acres is \$246. See table 21. When the interest on investment is deducted from net cash income \$39 remains, which represents the cash returns to the operator and his family for labor and management after all expenses are paid. This figure on the one-family, two-mule cotton farm is \$142. Obviously, this organization is inefficient and needs some adjustment to give the labor force more employment and to increase the farm income. The farm has 46.9 acres of woodland which the operators state is suitable for clearing. See table 30. The cropland can be increased by 30.3 acres, and the open pasture by 15.4 acres. This adjustment would, undoubtedly, result in a substantial increase in farm income.

The organization of the two-family size cotton farm can also be adjusted to conform to that of the one-family two-mule size cotton-dairy farm. This would increase the operator's cash returns above all farm expenses from \$157 to \$538, or 242.7 percent. See table 21. The adjustment would require reducing the labor force to one family, reducing the cropland by 3.9 acres, and increasing the cattle from 3 to 15 head, with no increase in pasture. The labor force would be employed near full time instead of 54 percent of its time as it now is. See table 28.

The organization of the two-family cotton farm can be adjusted to conform to that of the two-family cotton-cattle farm by clearing 7.7 acres of suitable woodland for crops, converting 2.1 acres of open pasture to crops, and increasing the cattle from 3 to 8 head. See table 29. The farm has 46.9 acres of woodland suited for clearing, out of which the 7.7 needed acres can come. See table 30. This adjustment would increase the cash income for the two families above all farm expenses from \$267 to \$494, or 85 percent. See table 29. The farm employment would be increased from 265 to 351 man-equivalent days, or 32.5 percent. The labor force is now employed only 54 percent of its available capacity. See table 28. The farm employment and farm income can be further increased by clearing more of the suitable woodland and expanding further in this direction.

The average size two-family cotton-cattle farm has 141 acres of farm land, of which 50.8 acres, or 36 percent, is woodland. The cash return to all labor and capital above all farm expenses is \$494, of which the operator's share is \$280. See table 29. The corresponding figure for the one-family two-mule cotton-cattle farm is \$251. See table 21. The farm income is low and the resident labor force is employed to only 54 percent of its capacity. The cropland on the farm can be increased by 35 acres through clearing suitable woodland and converting suitable open pasture to cropland. See table 30. By increasing either the cropland or cropland and pasture along with additional cattle, the farm income could be increased materially. The organization of the farm can be adjusted to conform to that of the one-family two-mule cotton-dairy units with no clearing. This adjustment would increase the operator's share of cash returns above all farm expenses from \$280 to \$538, or

Table 29—Farm organizations and incomes, multiple-family size farms, Brown Loam Area, 1941

Item	Size and type of farm				
	Two-family cotton	Two-family cotton-cattle	Three-family cotton	Three-family cotton-cattle	Two-and three- family cotton- livestock
Total investment ¹	\$2361	\$3056	\$4199	\$10,664	\$8,790
Acres in farm:	158	141	219	439	336
Cropland	43.2	53.0	118.4	99.6	126.5
Open pasture	34.0	31.9	34.5	137.7	88.0
Woods pastured	25.0	26.4	25.6	120.1	109.6
Woods not pastured	47.4	24.4	36.7	65.6	9.5
Other land	8.4	5.3	3.8	16.0	2.4
Cropland organization (acres):					
Cotton	9.7	13.1	30.3	27.0	12.8
Corn	17.1	21.3	55.2	41.8	51.0
Oats and lespedeza	0	.2	.3	2.1	14.0
Hay crops	6.0	9.3	16.7	18.0	41.2
Summer legumes turned under	1.6	1.6	1.4	.6	1.4
Garden and truck	.7	1.5	3.0	2.0	1.6
Sorghum for syrup	.9	1.1	2.3	.5	.8
Sweetpotatoes	.7	.5	1.1	.5	1.2
Idle cropland	5.7	4.4	8.1	7.1	2.5
Livestock organization ² :					
Workstock	3	3	6	6	7
Cows	3	8	6	27	25
Sows	1	1	1	2	7
Meat hogs	3	5	4	5	4
Chickens	31	48	41	49	47

¹Includes value of workstock and equipment owned by share renters.²Workstock includes those of operator and share renters; all other classes of livestock include only those of the operator.

Table 29—(continued)—Farm organizations and incomes, multiple-family size farms, Brown Loam Area, 1941³

Item	Size and type of farm				
	Two-family cotton	Two-family cotton-cattle	Three-family cotton	Three-family cotton-cattle	Two- and three- family cotton- livestock
	dollars	dollars	dollars	dollars	dollars
Cash income ⁴ :					
Crop receipts ⁶	387	629	1,529	1,449	1,027
Livestock receipts	61	173	152	438	1,273
Gross cash income	448	802	1,681	1,887	2,300
Cash farm expenses ⁴	134	233	391	512	796
Net cash income	314	569	1,290	1,375	1,504
Operator's share	203	353	615	708	1,391
Tenant's share	111	216	675	667	213
Non-cash farm expenses ⁴	47	75	112	181	303
Cash above all farm expenses	267	494	1,178	1,194	1,201
Operator's share	157	280	505	531	988
Tenant's share	110	214	673	663	213
Interest on investment ⁴	118	153	210	533	439
Farm labor income ⁵ (cash above all expenses and interest on investment)	149	341	968	661	762
Operator's share	39	129	297	2	549
Tenant's share	110	212	671	659	213

³Income calculations based on average of prices paid and received by farmers of area during 1935-1939.⁴Represents total for the farms, including operators' and the tenants' portions.⁵Represents cash returns to labor and management for all persons on the farms.⁶Includes AAA payments made to the farms for the 1941 crop year.

Table 30—Present and potential land use, multiple-family size farms, Brown Loam Area, 1941¹

Land use	Size and type of farm					
	Two-family		Three-family		Three-family	
	cotton	acres	cotton-cattle	cotton	cotton-cattle	cotton-livestock
Present land use						
			acres	acres	acres	acres
Cropland	43.2		53.0	118.4	99.6	126.5
Open pasture	34.0		31.9	34.5	137.7	88.0
Woods pastured	25.0		26.4	25.6	120.1	109.6
Woods not pastured	47.4		24.4	36.7	65.6	9.5
Other land	8.4		5.3	3.8	16.0	2.4
Total	158.0		141.0	219.0	439.0	336.0
Potential land use: converting suitable pasture land to crops and fencing woodland						
Cropland	66.9		73.6	127.1	140.8	176.5
Open pasture	10.3		11.3	25.8	96.5	38.0
Woods pastured	72.4		50.8	62.3	185.7	119.1
Woods not pastured	0		0	0	0	0
Other land	8.4		5.3	3.8	16.0	2.4
Total	158.0		141.0	219.0	439.0	336.0
Potential land use: clearing and converting suitable woodland to crops and open pasture						
Cropland	73.5		88.1	143.6	207.1	215.3
Open pasture	50.6		21.3	33.8	108.3	40.0
Woods pastured	25.5		26.3	37.8	107.6	80.1
Woods not pastured	0		0	0	0	0
Other land	8.4		5.3	3.8	16.0	2.4
Total	158.0		141.0	219.0	439.0	336.0

¹Based on farmers' estimates of land capabilities.

92 percent. See table 21. The adjustment would require reducing the labor force to one-family, reducing the cropland by 13.7 acres, no change in pasture, and an increase of 7 in the number of cattle. The labor force would be employed fully instead of only 54 percent of its capacity as at present. See table 28.

The average size three-family cotton farm has 219 acres of farm land of which 62 acres is woodland. The operators' share of cash returns above all farm costs is \$505. See table 29. This compares with \$538 for that of the one-family two-mule cotton-dairy farm of 122 acres. See table 21. The cash return to the operator and his family for labor and management after interest on investment is deducted is \$295, as compared with \$373 on the one-family cotton-dairy farm. The labor force on this farm is equal to 1,363 man-equivalent days, and is employed 54 percent of the time. See table 28. This farm could meet the production capacity of the one-family two-mule cotton-dairy farm and have 79 acres of cropland left, with no adjustment other than an addition of 9 dairy cows. By working out a satisfactory livestock leasing agreement between the operator and his tenants, or by employing the tenants on a cash basis and expanding further in this direction, the farm income could be greatly increased above its present level or that of the one-family cotton-dairy farm.

The cropland can be increased by 25 acres without lowering the pasture acreage. See table 30. This adjustment alone would increase the farm income by a considerable amount.

The three-family cotton-cattle farm of average size has 439 acres of farm land, of which 186, or 42 percent, is woodland. The resident labor force is employed to only 52 percent of its capacity. See table 28. The operator's share of cash returns above all farm expenses is \$531. See table 29. The corresponding figure on the one-family size cotton-dairy farm of 122 acres is \$538. See table 21. After deducting 5 percent interest on investment from cash returns above all farm expenses, the remainder is \$2 on this farm as compared to \$373 for the one-family size cotton-dairy farm. This figure represents the cash returns to the operator and his family for labor and management. The income from this farm can be increased materially through increasing the acreage in crops. The cropland can be increased by 107 acres, leaving enough pasture to carry the present livestock. This would require clearing of 78 acres out of 186 acres of woodland now on the farm. The remaining 29 acres of cropland could come from open pasture. See table 30.

The organization of the farm can be adjusted to conform to that of the two- and three-family cotton-cattle farm with no clearing of woodland. This adjustment would increase the operator's share of cash returns above all farm expenses from \$531 to \$988, or 86.1 percent. See table 29. The adjustment would require a shifting of 27 acres of suitable open pasture to cropland, an increase of 1 head of work stock, an increase of 5 brood sows, and a shift from 27 farm cattle to 25 head of dairy cattle. The farm income could be

increased further through clearing of suitable woodland and expanding further in the direction of cotton-livestock farming.

The two- and three-family cotton-livestock farm of average size has 336 acres of farm land, of which 119, or 32 percent, is in woodland. See table 29. Only 9.5 acres of the woodland is not pastured. The resident labor force is composed of 731 man-equivalent days per year, of which 80 percent is employed. See table 28. The operator's share of cash returns above all farm expenses is \$988. After deducting interest on investment, the cash return to the operator and his family for labor and management is \$549. See table 29. In terms of employment of available labor, utilization of natural resources, and income produced, the cotton-livestock farm represents the most efficient type of farm organization found among the larger units. The typical organization of this type farm has a dairy enterprise of considerable importance, along with a good size hog enterprise. The farms also have a high acreage of hay crops and are the only ones on which any considerable acreage of oats is found. These farms are also the only ones that have commercial hog enterprises of significance. The cats and clover hays are grazed freely by both cattle and hogs. The operators state that to raise hogs or cows successfully, plenty of pasture as well as an abundance of harvested feeds, especially roughages, are required.

OTHER ADJUSTMENT POSSIBILITIES

An attempt has been made in this bulletin to point out some adjustments in the organization and operation of farms in the area that will increase farm employment, promote a better utilization of natural resources, and increase farmers' incomes. The adjustments suggested have dealt with enterprises supplemental to cotton which are most commonly known and which have the widest range of application, namely, livestock enterprises. Time and space do not permit a coverage of all possible farm adjustments; also, data are limited on the less well-known enterprises. It is recognized, however, that on a number of farms, adjustments other than those pointed out may be made that will achieve the same desired results. Mention should be made especially of certain truck crops, in areas close to processing plants or established markets for fresh vegetables, clovers for hay and seed purposes, and small grains. These are found to be well adapted and to produce well on some farms in the area.

SUMMARY AND CONCLUSIONS

Farm incomes are low on most farms in the Brown Loam Area. The chief factors associated with low farm incomes are: (1) under-employment, which results mainly from lack of diversification in enterprises so as to distribute labor requirements throughout the year, and from farm operations that are too small to provide full employment for the labor force at any time of the year; (2) the failure of farmers fully to utilize available natural resources.

Financial returns can be increased on most low income farms by adjusting cropland and livestock organization to conform to that of other farms of similar size in the area on which higher incomes are now produced. The incomes on many of the farms can be increased through increasing the size of the farm business and by converting more of the suitable farm land to a more intensive use.

Brown loam farms that maintain supplementary dairy enterprises along with cotton furnish year-round employment for the resident labor force and produce the highest farm incomes. Likewise farms having supplementary beef cattle enterprises provide more employment and produce higher incomes than those having only cotton as a cash enterprise. On all farms except those having a commercial dairy enterprise and those having the larger beef cattle enterprise, the resident labor force is unemployed about half of the time.

Cotton yields the highest cash return per day of labor of any of the enterprises found on farms in the area; but due to the seasonal nature of its labor requirements the acreage of cotton a family can produce and harvest is so limited that, alone, cotton does not yield an income sufficient to meet the family requirements. Other enterprises are needed to provide employment at times of the year when there is little or no work to be done on a cotton farm.

Small one-cash crop farms predominate in the area. Three-fourths of all operating units are one-family-size farms; 44 percent of all operating units have less than 20 acres of cropland.¹ Although there is a marked trend toward diversification through livestock enterprise, 50 percent of all farms in the area have no significant cash enterprise other than cotton.

There have been some marked changes in the agriculture of the area during the past 40 years. Total farm land has decreased 10.7 percent, improved land 18 percent, and woodland 21 percent; while other land in farms, a large proportion of which is gullies and waste land, has increased 27 percent. Cotton acreage during this period has decreased 58.3 percent; hay crops increased 73.5 percent; and oats 52.6 percent. The numbers of cattle kept on farms have increased 53.1 percent. Cattle 2 years old or over kept for beef

¹An operating unit or a farm consists of all the land included in one AAA contract and cultivated by one set of machinery. It may include the land farmed by more than one family.

have increased 162.4 percent, and those kept for dairy have increased 23 percent. Workstock, hogs, and sheep have decreased 33.7, 16.1, and 70.3 percent, respectively, since 1900.

During the past 10 years there has been a marked trend away from cash crop enterprises to a subsistence and livestock type of farming in the area. The value of all farm products decreased 37.5 percent from 1930 to 1940.

This decrease in the value of crops sold was much greater, however, than in the values of livestock and livestock products sold, and in the value of farm products used by the families. The proportion of farm income from crop sales decreased from 63.7 to 52.3 percent during the 10-year period, while the proportion from the sale of livestock and livestock products increased from 14.4 to 15.4 percent and the proportion from farm products used by the family increased from 19.5 to 31.0 percent.

Notwithstanding recent increases, the production of hays and roughages is greatly deficient for livestock now in the area. Grain feeds are only slightly deficient; and there is an abundance of pasture, the carrying capacity of which can be increased several fold through improvement practices.

One-third of the AAA farm operators in the area are tenants. These operators are located on the smaller and less diversified farms. Lack of diversification in livestock enterprises on the rented farms may result in part from the shortness of the terms of tenant-operator leases, 88 percent running for only one year and 80 percent of the leases being oral agreements.

The use of fertilizers is far below what it could profitably be. Results secured by farmers using fertilizers indicate that good returns are received from their use in liberal quantities.

The total population in the area has increased 13.2 percent since 1900. But the rural population has, in the same period, decreased from 84.3 percent to 61.7 percent of the total, and the Negro population has decreased from 74.5 to 62.1 percent of the total.

APPENDIX

Table 1.—Labor requirements per acre of crops and unit of livestock, Brown Loam Area, 1941¹

Item	Total hours		Distribution of man hours by months												Oct.	Nov.	Dec.
	Man	Mule	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.						
Cotton	122.0	42	.1	.6	2.0	8.4	16.1	16.1	8.1	8.3	31.3	28.2	2.6	.2			
Corn	40.0	36	.3	.9	7.0	6.0	6.7	9.9	1.0	0	2.0	3.1	3.1				
Oats (grain)	13.5	18		1.0				4.5			2.0	4.0	2.0				
Hay crops	19.0	38		2.0	1.0		4.0	1.0		11.0							
Sorghum (syrup)	100.0	80			4.0	7.0	25.0	10.0	2.0	20.0	20.0	12.0					
Sweetpotatoes	112.0	48			8.5	18.5	24.4	8.6			9.5	42.5					
Irish potatoes	87.0	43	1.7	8.6	13.0	7.7	17.7	38.3									
Peanuts	7.4	42	4.0	6.0	4.0	9.0	13.6	6.0	1.0		16.0	14.0					
Truck and garden	123.7	35	2.5	2.5	17.5	22.5	17.5	17.5	12.5	10.0	10.0	10.0	1.0	.2			
Milk cows ²	135.6		11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3			
Beef cows ²	15.6		1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3			
Hogs ²	26.4		2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2			

¹Represents the average on all farms studied, based on horse-drawn equipment.²All classes of livestock based on mature animals and includes replacement stock kept.

Table 2—Prices used in calculating "normalized" farm income, Brown Loam Area, 1941

Item	Average prices ¹ received 1935-1939	Price interpolations used
Cotton, lint (lb.)	\$.102	
Cottonseed (ton)	25.00	
Beef cattle (cwt.)		
Calves	6.00	{ 1st year calf, 275 lbs. or \$16.50
Cows	4.25	{ 2nd year calf, 425 lbs. or \$22.50
Scrub dairy cows	4.00	Weight 700 lbs., price \$29.75
Hogs		Weight 625 lbs., price \$25.00
Market size (cwt.)	7.80	Dressed pork for home use, 11.5 cents
Chickens (lb.)	.16	Per head eaten and sold, 40 cents
Eggs (doz.)	.17	Same for family use
Butterfat (lb.)	.27	Butter, 25 cents
Milk, whole (cwt.)	1.69	Per gallon home use, 15 cents
Corn (bu.)	.75	Same for family use
Oats (bu.)	.55	
Sweetpotatoes (bu.)	.78	Same for family use
Irish potatoes (bu.)	.80	Same for family use
Peanuts (bu.)	1.00	Same for family use
Garden (acre)	100.00	All gardens held between \$15.00 and \$100.00
Syrup (gal.)	.40	Same for family use
Canned fruit (qt.)	.15	Family use only
Peas and beans (bu.)	1.00	Same for family use
Fuel wood (cord)	2.00	Same for family use

¹Prices obtained from Agricultural Marketing Service for the crop reporting districts in the area for the 5 years.

Table 3—Prices used in calculating "normalized" farm income, Brown Loam Area, 1941¹

Item ²	Unit	Average prices paid 1935-1939
Hired labor:		
Cotton chopping	day	\$.75
Cotton picking	cwt.	.65
Other day labor	day	.90
Month help	month	12.35
Board	month	6.15
Feeds bought:		
Corn	bu.	.75
Hay	ton	10.00
Cottonseed meal	ton	30.00
Cottonseed hulls	ton	7.00
Oats	bu.	.53
Dairy feed (16%)	ton	35.00
Wheat shorts	cwt.	1.75
Fertilizer:		
4-8-4	ton	26.50
6-8-8	ton	30.00
6-12-6	ton	33.00
Nitrate of soda	ton	35.00
Acid phosphate	ton	21.00
Milk hauling	cwt.	.275

¹Prices obtained from Agricultural Marketing Service for the crop reporting districts in the area for the 5-year period.

²All other cash costs used as reported in farm schedules, 1941.

Table 4—Rates charged for depreciation and repair costs, Brown Loam Area

Item	Depreciation	Repair cost
Horse-drawn equipment	10% of present value ¹	5% of present value ¹
Tractor and tractor equipment	20% of present value	8% of present value
Buildings	4% of present value	2% of present value
Workstock	\$9 per head	

¹Present value calculated by taking one-half of new value for each item as listed by retail dealers.

Table 5—Average feed requirements and cash returns per cow kept in Brown Loam Area, 1941^{1,2}

Beef and general purpose cows		Dairy cows	
	Requirements		
Corn	.15 acre	Corn	.12 acre
Hay	.4 acre	Hay	.43 acre
Open pasture	2.5 acres	Open pasture	1.43 acres
Woods pasture	2.9 acres	Woods pasture	2.30 acres
Bought feed	\$1.00	Oats	.12 acre
		Bought feed	\$21.27
		Hauling costs for milk	8.27
	Returns		
Beef sales	\$16.00	Milk sales	\$51.24
		Beef sales	8.27

¹Includes replacement stock kept.

²Income calculations based on average of prices paid and received by farms in the area, 1935-1939.

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THE PLANTATION LAND TENURE SYSTEM

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THE PLANTATION LAND TENURE SYSTEM

in

MISSISSIPPI

by

FRANK J. WELCH¹

The interest in and importance of land tenure in Mississippi are due to the high percentage of tenancy in the State and particularly the high percentage of tenancy within certain areas of the State. The approximate percentage of farm tenancy in 1940 for the nation was 39 percent, for Mississippi 66 percent, and for the concentrated plantation area of the Yazoo-Mississippi Delta 91 percent. Tenancy is naturally high in the concentrated plantation areas because of the characteristics of this particular type of farm organization.

It is often difficult for interested persons not acquainted with the plantation system to understand its organization and operation. In fact, it is difficult even after careful study to analyze and interpret the plantation without neglecting important factors and forces. A complete analysis would involve a consideration of the political and social as well as the economic forces that have been important in its evolution through the years.

Scope and Objectives

This study will be concerned primarily with the tenancy aspects of the Mississippi plantation, with particular reference to the Delta area. The primary objective of this study is to provide the basis for a better understanding of the plantation economy as it relates to tenancy. More specifically, the objectives may be stated as follows: (1) to indicate briefly the origin and development of the plantation system; (2) to delineate the recessive and the dominant plantation areas in the state and examine the physical and economic forces that have influenced the plantation system within each of these areas; (3) to examine the relative economy of plantation operation; (4) to indicate use and source of seasonal labor, extent of employment and levels of income, and mobility of plantation labor; and finally, (5) to indicate trends within the plantation economy with reference to mechanization, shifts in farm labor organization and tenancy patterns, and changes in land-use that are tending to affect the plantation economy.

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Definition of Terms

Certain data from the United States census have been used in this report. When such data were used, census terminology necessarily had to be used. Since, however, many census terms (farm, operator, tenant, for example) are misleading when used in relation to plantation organization, unless properly interpreted, a definition of terms is presented here. These terms will always carry the meanings indicated, regardless of census definition, unless otherwise indicated.

Delta—The abbreviated term for the Yazoo-Mississippi Delta area.¹

Plantation—The plantation will be considered as a unified agricultural organization of approximately 100 acres or more of cropland in one tract or in tracts in proximity to each other, operated with wage labor, croppers, tenants, or any combination of the three, managed as a single unit in respect to the contract of labor and of production, and having cotton as the major enterprise.

Planter—The owner or operator of a plantation.

Operator—A person who operates and directs a plantation unit on his own responsibility. The term includes planters, and it also includes non-owners who have the general control of a plantation unit at a given time. It includes such persons as cash renters, share or standing renters of units large enough to be classified as plantations, managers of corporate, joint stock and partnership units, and others who fall within this general classification.

Plantation Management—The responsible power and authority for the direction and operation of a plantation. The managerial functions may be administered by planters, operators, managers, or a combination of any of these three.

Plantation labor force—Includes all labor on the plantation unit (tenants, sharecroppers, regular wage families, and seasonal laborers) except the operator and the members of his family.

Sharecropper (cropper)—A member of the plantation labor force who contributes his labor and the labor of his family to the production of the crop and receives a stipulated share of the products as compensation for his and his family's labor, usually one-half. The plantation operator provides a house, farm power and equipment, planting seed, and supervision; and he usually provides credit for the cropper's current expenses up to harvest time, and himself pays for one-half the fertilizer, insecticides, and ginning. Some important changes, however, have recently been made with reference to inputs and distributions as between landlords and croppers.

¹Unless otherwise indicated, the Delta as used in this report will include the following counties: Bolivar, Coahoma, Humphreys, Issaquena, Leflore, Quitman, Sharkey, Sunflower, Tunica, and Washington.

Share tenant—One who, in addition to contributing the necessary labor for the production of the crop, also contributes the farm power and equipment, seed, and his portion (determined by share of the crops) of fertilizer, insecticides, and other production costs. The share tenant usually receives three-fourths of the cotton and two-thirds of the other crops for his contribution. As a rule, under the plantation system, the share tenant receives about as much supervision as does the sharecropper.

Cash or standing tenant—A member of the plantation labor force who pays a fixed amount of money or crops for the use of the land. He usually provides farm power and equipment. He is, however, subject to the detailed supervision of the management. Very few cash or standing tenants are found on Mississippi plantations.

Tenants—A generic term used to include share tenants and cash and standing tenants.

Cropper-laborer (combination worker)—A member of the plantation labor force who cultivates some crop acres on a share basis the same as croppers, but who also works for day wages in the operator's crops for 50 percent or more of his annual income.

Wage worker—A person who works as a regular farm laborer during all or practically all the year for wages in the operation of the plantation unit.

Seasonal-laborer—One who works intermittently or irregularly for wages.

Furnish—A term used to designate the credit advanced by the plantation management to croppers and tenants for their living expenses and their share of the crop production costs.

Method of Study

Data for this study have been drawn from many sources. The State Extension Service, Agricultural Adjustment Agency and the Delta Council have provided valuable information and helpful suggestions. Census data and information secured from other Federal and State agencies have been used freely. The basic information for the report, however, was secured by means of questionnaires from plantation operators and plantation labor force during the year 1941. Farm management data were secured for the crop year 1940.

Sampling Procedure

The four counties of Leflore, Washington, Sharkey, and Tunica were selected for intensive study.² The sample area was selected, in consultation with representatives of the Delta Council and the State Extension Service, as being representative of the Delta area.

²See figure 1 for location of sample counties.

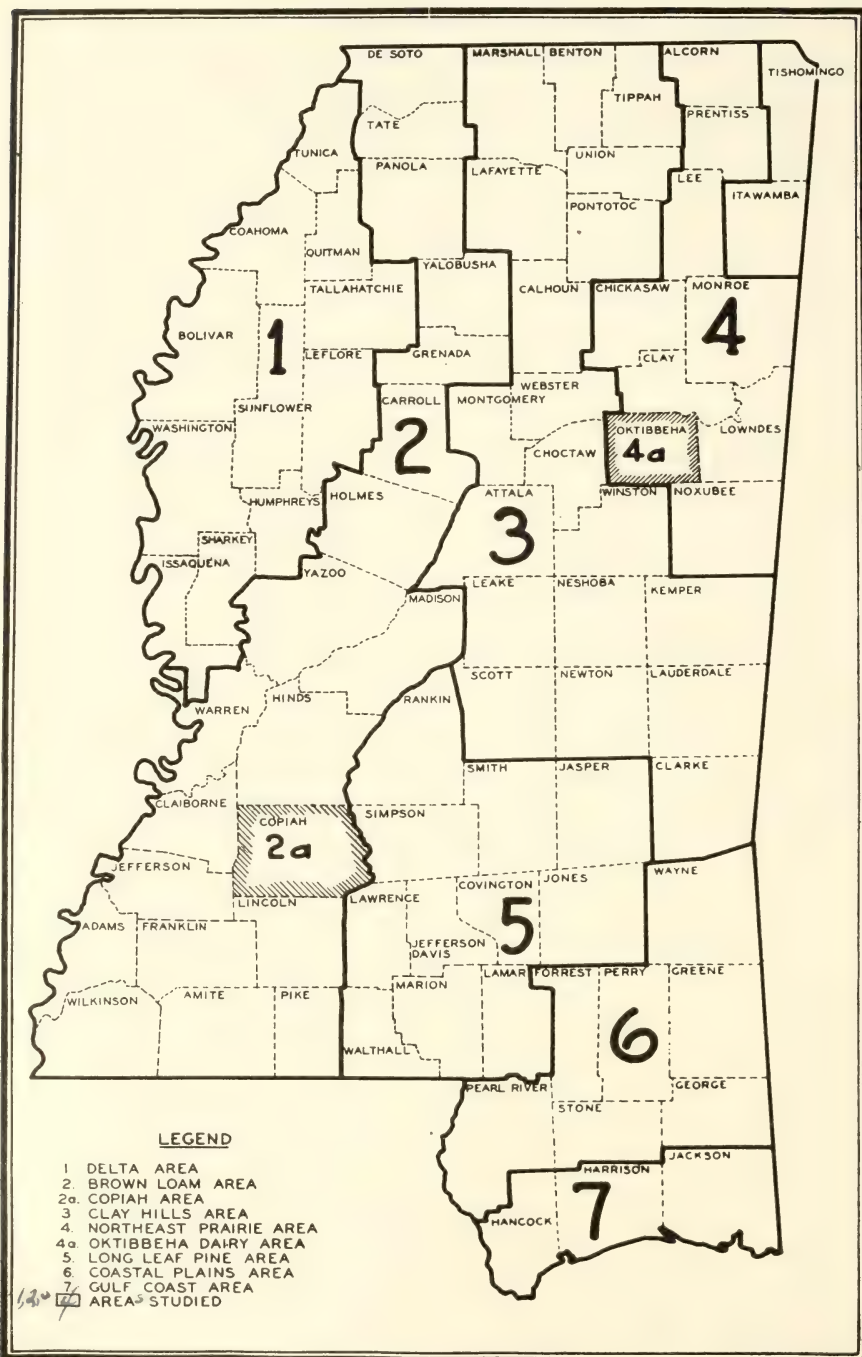


Figure 1. Type-of-farming areas in Mississippi.

Information was secured from county Agricultural Adjustment Agency records on plantations of 100 crop acres and above that had a continuous record as an operating unit from 1935 to 1940, on: (a) total crop and farm land; (b) number of tenants; (c) cotton acres by tenure; (d) Agricultural Adjustment Agency cooperation; (e) cotton acreage and production; and (f) the relative basis on which landlord and tenant shared the cotton crop.

These record sheets were arrayed on the basis of size, and a sample of approximately 20 percent of the total worksheets for each county was selected for intensive study by means of questionnaires for both operators and members of the plantation labor force. This number was further reduced, however, by approximately 2 percent due to difficulties in the field in getting some of the schedules, and to rejection of some of the schedules because of inadequacies or incompleteness. A total of 76 operator schedules were used in the final tabulation.

A sample of approximately 12 percent of the total labor force on the 76 sample plantations was used. The number of tenant families on each individual unit was secured from county Agricultural Adjustment Agency records, but, the number of wage hands and wage families was not known until after interview with the operator.

No strictly percentage basis was followed in taking the tenant-laborer schedules. At least one tenant-laborer schedule was secured on every plantation despite the fact that a rigid adherence to a percentage basis would have excluded some of the smaller units. On the larger plantations, not more than 12 percent of the labor force were interviewed. The relationship practices and patterns on the larger units could be determined without including more than 12 percent of the total labor force. For these reasons the percentage basis for the selection of tenants and laborers was not followed.

History and Development

The modern plantation had its origin in the early colonial settlements in the New World in the early 17th Century. Wherever climate, soil, and topography were favorable to the routine production of tropical or semi-tropical crops, the plantation was an integral part of the process of colonization by English, French, Spanish, Dutch, and Portuguese settlers. The plantation proved to be an effective agency for the production of commercial crops in the undeveloped tropical and semi-tropical areas of the New World.

The early plantation labor force was composed of indentured servants, poor debtors released from English prisons, and a few natives, who generally proved to be unsatisfactory plantation workers. This type of labor, however, soon gave way to Negroes imported in bondage. Labor was needed so badly and Negroes were to be had so cheaply and slavery seemed to be such a simple and advantageous device that little or no qualms were held as to its future impli-

cations. The system became firmly established in the southern colonies, where such staple products as indigo, tobacco, sugarcane, and cotton could be grown to distinct economic advantage under such a system.

Long before 1860 the plantation system became the dominant political, social, and economic force in the southern states. It naturally developed distinctive characteristics peculiar to a slave economy. When the slavery system was finally eliminated by proclamation and force of arms during the Civil War period, the former Negro slave labor still remained as a serious social and economic problem that had to be faced by both whites and blacks.

The Civil War and reconstruction destroyed the slave economy and social order of the South. The plantation owners found themselves with land, general impoverishment, and little or no labor. The former slaves found themselves with freedom, but without land or capital, and without self-discipline or the ability to enter at once into the spirit and tradition of a free competitive industrial society. The efforts of the planters to employ the former slaves as wage workers seldom proved successful. As a consequence, urgent expediency brought together the landowner with little money but with some credit and with managerial ability and the tradition to govern and rule, and the traditionally servile former slaves, who lacked managerial ability, land, money, and credit, into a working arrangement that has come to be known as the plantation-share-cropper system. As would be expected, many characteristics and attitudes of the old system were carried by both whites and blacks over to the new order.

Under this system the plantation operator provided land, a house, fuel, implements, workstock, seed, supervision, and advanced food and clothing until the crops were made and sold. The crops were divided on a half-and-half basis. With slight modification, this system is still dominant in the plantation areas.

Some few croppers, as time went by, acquired mules and equipment and became share tenants. These tenants, however, were usually supervised about as closely as were croppers, and depended on the plantation management for furnish as did the croppers. The vast majority of the plantation labor force have always been croppers.

PRINCIPAL PLANTATION AREAS IN MISSISSIPPI

Although in Mississippi the plantation is not limited to any particular area, the Yazoo-Mississippi Delta is the important plantation area for the State and, as for that, it is the super-plantation area of the country. There are two other areas in the State where the plantation was at one time dominant and is still important; but, due to changed economic and physiographic conditions, these two areas now have more livestock, dairy, and small farm operations than in the past. These are the Brown Loam and the Black Prairie areas. See figure 1 for type-of-farming areas.

The Black Prairie

The Black Prairie area that extends from Central Alabama into Northeast Mississippi includes about 300,000 acres in Mississippi, mostly in eight counties. Before the Civil War it was one of the important plantation areas of the South. It had a dense population of Negroes. As a plantation area, however, its decadence has been progressive. For the most part, the prairie is rolling; some of the non-characteristic soils are hilly. The rainfall is heavy, as it is throughout Mississippi. Under these conditions, and with clean row crop cultivation and lack of soil-conserving and soil-building methods, erosion and fertility depletion worked rapidly. In addition, the shock of the Civil War and reconstruction, speculation, depressions, price fluctuations, and the boll weevil have all tended to undermine the economic foundations of the plantation within this area. Erosion and depletion of the soil, however, have been the most important factors in the decline of the plantation. Figure 2 indicates the nearly complete destruction of the soil as found in parts of the area. The completely denuded field indicated in the photograph was producing a bale of cotton to the acre at the time of the Civil War, according to one of the old settlers still living in the community.

Table 1—Population, total and Negro, cotton acreage and production, percentage of tenancy, and number of cattle, 1880-1940, in six part-Prairie counties.¹

Year	Total population	Negro population	Percent Negro	Cotton acreage	Production (bales)	Percentage of tenancy	All cattle
1880	140,486	92,021	65.5	328,468	108,482	49.3	60,919
1890	141,456	94,730	67.0	367,432	84,675	75.2	81,170
1900	152,859	112,434	73.6	346,020	116,013	70.6	80,668
1910	163,157	102,713	63.0	403,452	99,962	71.7	82,199
1920	147,935	82,387	55.7	227,176	55,532	66.8	106,135
1930	164,051	87,169	53.1	316,457	121,248	73.3 ²	124,167
1940	178,581	92,639	51.9	164,321	49,258	67.3 ³	132,910

Source: The United States Census.

¹Clay, Lee, Lowndes, Monroe, Noxubee, and Oktibbeha.

²Croppers were 35.7 percent of all operators; other tenants, 37.6 percent.

³Croppers were 35.4 percent of all operators; other tenants, 31.9 percent.

At the present time, the prairie is being increasingly given over to pasture and hay crops, and dairy and beef cattle. The remaining plantations have much of their lands in pasture. Many old places have a few tenants who each milk a few cows and grow a little cotton. The large numbers of Negroes, the furnish system, the one-crop system, and the supervision that are characteristic of the plantation, are all becoming of less importance. See table 1.

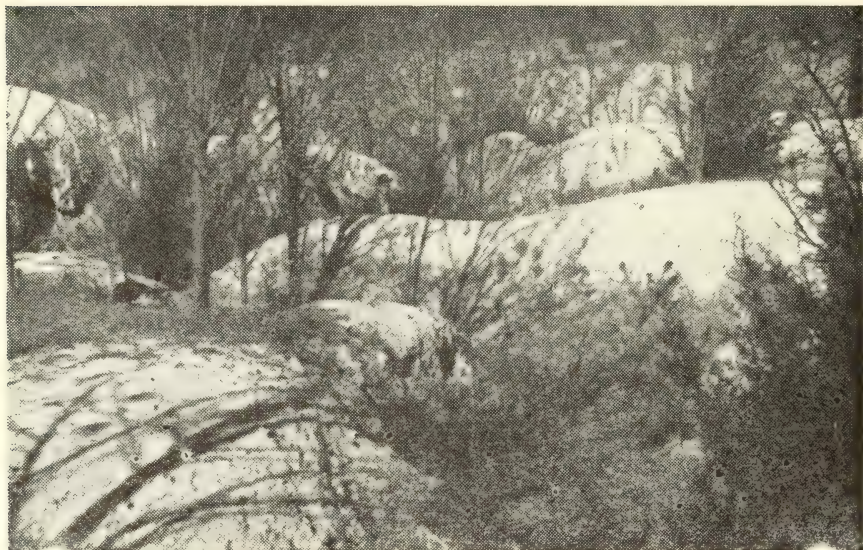


Figure 2. Two views of the same field in the Black Prairie now completely destroyed for agricultural purposes by erosion. This field was producing a bale of cotton to the acre in 1860.

The Brown Loam

Another recessive plantation area of the State is the Brown Loam area. This area extends the entire length of the State, from Tennessee to Louisiana.

The breadth east and west is irregular, and is greatest at the two extremities, the northern and the southern, where it is 60 to 70 miles. See figure 1.

The soils of this area are mostly of the Loess and Brown Loam formations. In the early days of development they were highly productive. The main crops were cotton, corn, and some truck, but mostly cotton.

The plantation economy in the southern part of the Brown Loam area during the ante-bellum period approached the South of the legend in its classical form more closely than in any other section of the State. Some of the largest and most prosperous plantations in the state flourished in the Natchez district, which included the present counties of Adams, Wilkinson, Claiborne, Jefferson, and Warren. Magnificent colonial homes with their shining silver and imported furniture, and distinguished men of letters and politics, were characteristic of the old Natchez region in Southwest Mississippi.³

The causes of the decline of the plantation in the Brown Loam area were essentially the same as those operating in the Black Prairie. The disruption of the plantation system during the war period and the years of reconstruction forced many of the plantations into bankruptcy and dissolution. The coming of the boll weevil about 1908 caused particularly severe economic panic in this area. But, no doubt, the principal cause of the decay of the plantation was the loss of fertile top soil through progressive erosion. Because of the rugged and rolling topography of much of the area and the intensive cultivation of row crops, erosion took severe toll of the soil. Deep gullies have ruined considerable acreage of land in the rougher parts of the area and shallow gullies and sheet erosion have ruined or severely damaged much of the undulating land. See figure 3. Today the Brown Loam area is dotted with cattle farms and small family-size farms; plantation units are scattered here and there, but no longer provide the major pattern of farm organization for the area. See table 2.

³Within recent years interest in the history and pageantry of the ante-bellum era in the Natchez area has been revived by the "Natchez Pilgrimage" organization.

Table 2—Population, total and Negro, cotton acreage and production, percentage of tenancy, and number of cattle, 1880-1940, in six counties in the Brown-Loam-Natchez District¹

Year	Total population	Negro population	Percent Negro	Cotton acreage	Production (bales)	Percentage of tenancy	All cattle
1880	98,279	68,962	70.2	177,059	90,670	61.6	62,779
1890	105,708	75,388	71.3	232,857	122,735	71.8	75,921
1900	128,029	93,327	72.9	254,458	123,440	73.2	64,394
1910	117,112	81,120	69.3	157,962	40,727	69.9	90,491
1920	99,583	63,065	63.3	118,675	22,607	65.3	131,287
1930	95,944	60,369	62.9	85,981	42,143	68.4 ²	98,792
1940	104,368	65,026 ³	62.3	80,736	39,339	66.3 ³	107,708

Source: The United States Census.

¹Adams, Amite, Claiborne, Franklin, Jefferson, and Wilkinson.

²Croppers were 23.3 percent of all operators; other tenants, 45.1 percent.

³Croppers were 26.8 percent of all operators; other tenants, 39.5 percent.

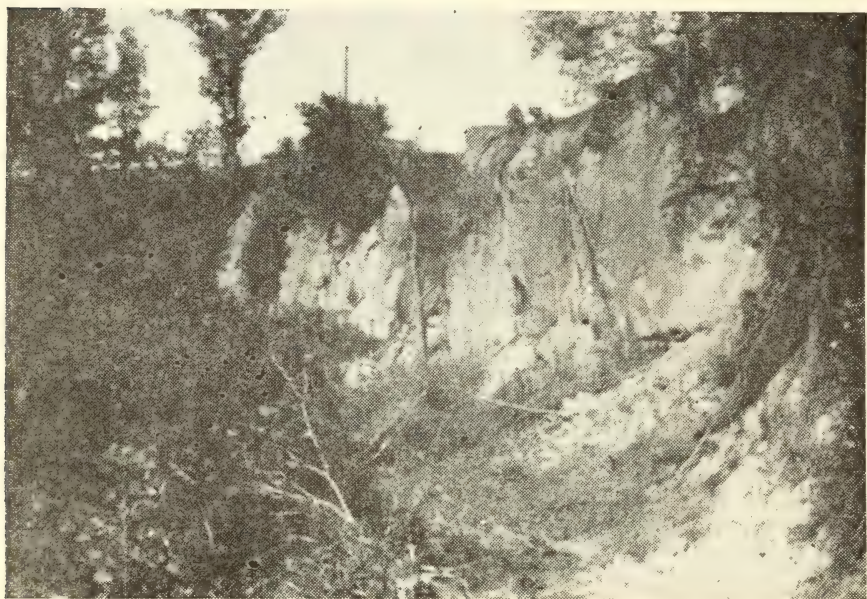


Figure 3. Severe erosion in the Brown Loam area has ruined thousands of acres of once highly fertile soils. Note the vertical smooth soil that is characteristic of eroded Loess soil.

The rise and decline of the plantation system in the two areas suggests the importance of soil and other physical factors to the successful operation of the plantation system. Large-scale production of a cash crop that lends itself to routine cultural and harvesting practices seems to be essential to successful plantation operation. Other once-dominant plantation areas in the South have followed the same general pattern of ascendancy and decline as the Black Prairie and Brown Loam areas of Mississippi.

THE DELTA: SUPER-PLANTATION AREA

By far the most important plantation area of the State at pres-

ent is the Yazoo-Mississippi Delta. This area lies in the northwestern part of the State within 33-35 degrees latitude (except southern tip), and 89 to 91 degrees longitude. It comprises an area of some 5 million acres, approximately 18 percent of the total land area of the State, and includes all of 10 counties and parts of 9 others.⁴ See figure 1. The western boundary is some three hundred miles of Mississippi River levee. The area is marked on the east by a ring of low undulating hills that rise out of the river banks near Memphis and Vicksburg and form a partial crescent by sweeping back some fifty miles from the river at the widest point in the Delta.

Elevation of the Delta above sea level ranges from about 100 feet in the southern part to 190 feet in the northern part. The surface is almost level, with the higher and better-drained land adjacent to the streams, lakes, and old stream beds.

Early Development and Settlement of Delta

The Yazoo-Mississippi Delta was settled and developed as a part of the expanding empire of cotton during the quarter of a century or a little more before the Civil War. It was slow to develop as compared with the other parts of the State. As late as 1820 none of the present Delta counties was in existence. The dense forest and underbrush, flood and drainage problems, and lack of transportation facilities hindered the rapid development of the rich Delta land.

The early plantations were located along the banks of the Mississippi and Yazoo Rivers. Here lie the rich loamy soils, and their elevation is greater than that of the surrounding back country. Also, the streams were the only transportation outlets in the early days. Railroads had not been developed and roads were impassible during many weeks of the year.

Plantation System Has Grown in Importance

The plantation in the Delta, unlike its counterpart in the Black Prairie and Brown Loam areas, is more important than during the period of slavery. Much of the Delta was undeveloped at the time of the Civil War, and the plantation development under the share-cropper plan has gone hand-in-hand with the clearing and opening of new land.

Before the advent of the Agricultural Adjustment Agency program, 78 percent of the cropland was planted to cotton, 89 percent of the farm land was operated under the plantation system, and 95 percent of the farms were operated by croppers and tenants. Within this area is produced almost one-half the cotton crop of the State and about one-half of the total national production of quality cotton having a staple of one and one-eighth inches and longer.

⁴In addition to the ten counties already indicated as lying wholly within the Delta, the nine part-Delta counties are: Desoto, Tate, Panola, Tallahatchie, Grenada, Carroll, Holmes, Yazoo, and Warren.

As an indication of the trend in population by races,⁵ percentage of tenancy, and total cotton production in the Delta since 1860, see table 3. Some shifts and adjustments in the plantation organization have been made during the past decade, but the basic pattern has not been materially altered.

A number of factors, physical, economic, and racial, have tended to make the Delta the "super-plantation" area of the country. The physical factors, as already indicated, are very important to the successful operation of the plantation system. The dense forest and underbrush, mosquitoes and malaria, and serious flood and drainage problems, made it difficult for small operators with little or no

Table 3—Population by race, percentage of tenancy and total cotton production, Delta counties. 1840-1940

Year	Negro	White	Percent Negro to total	Percent tenancy	Total cotton production ⁵
1840 ¹	44,330 ²	27,310	61.9	(4)	(4)
1860	116,021 ²	48,993	70.3	(4)	100,972
1880 ³	81,955	16,657	83.1	(4)	185,868
1900	171,209	23,970	87.7	89.8	315,501
1920	255,583	59,237	81.2	94.1	419,626
1940	290,791	104,376	73.6	90.6	782,347

Source: United States Census.

¹Data for 1840 and 1860 pertain to the following Delta and part Delta counties: Bolivar, Carroll, Coahoma, DeSoto, Holmes, Panola, Tallahatchie, Tunica, Warren, Washington, and Yazoo.

²Negro slaves.

³From 1880 through 1910, the Census data pertain to: Bolivar, Coahoma, Issaquena, Leflore, Quitman, Sharkey, Sunflower, Tunica, and Washington. For 1920 and 1940 the data pertain also to Humphreys County, organized in 1918.

⁴Information not available.

⁵In 500-pound bales.

capital to develop new land within the area. Hence the laborious task of clearing and opening this area fell to Negro slaves during the days of slavery, and thereafter largely to Negro laborers under the direction of plantation operators with capital. The sharecropper plantation system that followed the plantation-slave system has continued to grow in importance through the years.

The extent and importance of large-scale operation in the Delta are reflected by figures computed from county Agricultural Adjustment Agency worksheets in Sharkey, Tunica, and Washington Counties in 1940, indicating the relationship of the number of operators, and farm, crop, and cotton acres, to size groups. Operating units are a little larger on the whole than the figures indicate, because some operators filed more than one worksheet.⁶ See table 4.

⁵A discussion of racial composition as related to tenure groups will be found on p. 18 *infra*. See tables 5, 38, and 39.

⁶Operating unit as used here denotes the farm or plantation unit covered by each Agricultural Adjustment Agency worksheet. The operator is the person in whose name the worksheet is rendered and who manages the farm or plantation unit. Sharecropper and share tenant units are not regarded as operating units but merely as segments of the over-all unit.

Delta Land Suited to Plantation Operation

Once the new lands were opened up and drained, the large, almost level areas lent themselves to the production of a superior grade of cotton on a large scale. The soils are alluvial and deep. The soil types belong mostly to the Sarpy, Sharkey, and Yazoo series. These may be classed roughly into two broad divisions: (a) loam soils, containing a high proportion of sand in relation to clay, and

Table 4—Distribution of farm and plantation operators,¹ crop and cotton acreage by size groups based on crop acreage in three Delta counties, 1940.

Size range (crop acreage)	Number of operators	Percent of total	Farm acreage	Percent of total	Crop acreage	Percent of total	Cotton acreage	Percent of total
1-100	2,563	76.1	132,928	17.7	75,531	14.9	42,753	19.7
101-200	273	8.1	58,768	7.8	38,290	7.6	15,801	7.3
201-300	122	3.6	47,707	6.3	30,851	6.1	12,308	5.7
301-400	84	2.5	40,862	5.4	29,137	5.8	11,621	5.4
401-500	62	1.8	41,712	5.5	27,864	5.5	11,162	5.1
501-600	43	1.3	34,613	4.6	23,377	4.6	9,525	4.4
601-700	33	1.0	31,635	4.2	21,615	4.3	8,674	4.0
701-800	38	1.1	41,474	5.5	28,440	5.6	11,272	5.2
801-900	28	.8	31,435	4.2	23,963	4.7	9,790	4.5
901-1000	20	.6	28,181	3.8	18,639	3.7	7,421	3.4
1001-2000	76	2.3	149,176	19.8	103,375	20.5	41,429	19.1
2001- and above	28	.8	116,007	15.4	84,400	16.7	35,072	16.2
Totals	3,370	100.0	754,498	100.0	505,482	100.0	216,828	100.0

Source: Data compiled from Agricultural Adjustment Administration records in Sharkey, Tunica, and Washington Counties.

¹"Operators" as used here includes not only plantation operators as defined in the introduction of this manuscript but also all farm operators (persons with less than 100 acres cropland) who executed an Agricultural Adjustment Administration farm worksheet.

(b) the more extensive clay soils, containing a high proportion of clay in relation to sand. The latter comprises the so-called light and the heavy "buckshot" land. The loams are usually found adjacent to streams, lakes, and old stream beds where the largest amounts of sediment and the coarser soil particles were deposited by overflows. The smaller particles of soil were carried further from the point of overflow and deposited where the water currents were slower. Hence, the heavier type soils are usually found removed from the stream beds and in the lower areas.

Until comparatively recent years the recurring deposition of silt by frequent overflows served to renew the organic content and fertility of the soil. Little or no thought had to be given to the preservation or restoration of soil fertility. However, with the building of ever-higher levees to prevent floods, the older lands have given evidence of mineral and organic deficiencies. These deficiencies were becoming serious when the acreage curtailment program of the Department of Agriculture caused producers to become interested in high acre-yields in order to avoid a sharp decline in over-all production. As a consequence of the soil conservation and improve-

ment program, soil fertility practices in the form of interplanted soil-building crops, winter cover crops, the turning under of leguminous crops, systematic crop rotation, and the use of nitrogenous commercial fertilizers were generally adopted throughout the Delta. The result has been a very sharp increase in per acre production, as will be indicated later.

Climate and Rainfall Suited to Quality Cotton Production

The climate of the Delta area is semi-tropical, with a frost-free growing season of from 220 to 240 days. The winters are usually mild, and while the summers are hot, spring and autumn are usually long and pleasant. The annual average temperature as recorded at Greenville, Washington County, was 65.2 degrees Fahrenheit for the 5-year period, 1936-1940, inclusive.

The annual rainfall for the area is usually adequate to support growing crops, and does not fluctuate widely from year to year. General crop failure within the area due to too much or too little precipitation rarely occurs. The average annual rainfall as recorded at three different stations⁷ during the 5-year period, 1936-1940, was 48.42 inches.

The seasonal distribution of rainfall is particularly favorable to the production of high grade staple cotton. The rainfall is usually heaviest in winter and spring and reaches its lowest point in late summer and early fall. The light precipitation during the period of fruiting and harvesting make possible more effective insect control measures and the gathering of cotton with a minimum of weather damage.

Plantation Labor Supply

The plantation system requires an abundant supply of "common" farm labor amenable to detailed supervision and direction. The Delta area has had access to just such labor supply through the years. The system has consistently shown a decided preference for Negro labor. Consequently, 81.1 percent of the rural farm population of the Delta in 1940 was Negro. For detailed information relative to the population composition of the Delta, see tables 5 and 6.

Table 5—Racial composition of farm labor force by tenure group, Delta area. 1940

Total croppers	White croppers	Percent white	Tenants other than croppers	White tenants other than croppers	Percent white	Percent all white tenants of total
51,348	4,412	8.6	7,244	2,869	39.6	12.4

Source: United States Census, 1940, Agriculture, Mississippi, 1, pp. 26-33.

Table 6—Composition of Delta population by locations, urban, rural-nonfarm and rural-farm, 1940

URBAN			RURAL-NONFARM			RURAL-FARM		
White	Negro	Percent	White	Negro	Percent	White	Negro	Percent
28,590	35,019	55.1	22,173	22,927	50.8	54,266	232,845	81.1

Source: United States Census, 1940, Agriculture, Mississippi, 1, pp. 26-33.

⁷Belzoni, Greenville, and Clarksdale located in the southern, central, and northern parts of the Delta, respectively.

The plantation system neither encourages nor requires a high level of literacy on the part of its general labor force. As a consequence, the percentage of functional illiteracy is still high among Delta plantation labor groups. Even though some progress is being made in providing better educational opportunities within the area, it will take considerable time, at the present rate of progress, to raise the educational status of the plantation labor force very much above the prevailing low levels. See tables 7, 8, and 9.

Table 7—Degree of illiteracy and educational status of 220 heads of plantation labor families by tenancy groups, Mississippi Delta, 1940¹

Type of tenure	Number can read and write	Number cannot read and write	Percent total cannot read and write	Highest grade reached, those who read, write											
				1	2	3	4	5	6	7	8	9	10	11	12
Share-croppers	60	69	53.5	3	5	5	16	10	9	4	5	1	0	2	0
Share tenants	6	11	64.7	1	0	1	1	1	0	1	1	0	0	0	0
Cropper-wage	12	11	47.8	1	0	3	2	0	4	0	1	1	0	0	0
Wage workers	27	24	47.1	0	1	3	5	4	3	5	5	1	0	0	0
Total	105	115	52.3	5	6	12	24	15	16	10	12	3	0	2	0

Source: Sample 76 plantations from Delta plantation study.

¹Since there were only six white families in the sample, these were included with the Negro families.

Table 8—Degree of illiteracy and educational status of wives by tenure groups in 191 families, Mississippi Delta, 1940

Type of tenure	Number can read and write	Number cannot read and write	Percent total cannot read and write	NA ¹	Highest grade reached by those who can read and write										Over
					1	2	3	4	5	6	7	8	9	10	
Share-croppers	77	45	36.9	6	0	1	11	17	13	12	4	9	3	1	0
Share tenants	10	7	41.2	1	0	0	0	3	2	2	1	1	0	0	0
Cropper-wage	16	4	20.0	1	0	0	1	2	3	1	3	3	1	0	1
Wage workers	23	9	28.1	2	0	0	3	7	5	2	2	1	1	0	0
Total	126	65	34.0	10	0	1	15	29	23	17	10	14	5	1	1

Source: Sample 76 plantations, Delta study.

¹Information not available.

Note: There were 191 wives in the 220 farm families studied.

Table 9—School attendance record of children between ages 6-18 for calendar year 1940 and grade attainments for those who did attend school, 1940

Type of tenure	Number children reported	Number children in school	Number children not in school	Percent not in school	Grade attainment those in school ¹										
					1	2	3	4	5	6	7	8	9	10	11
Share-croppers	164	123	41	25.0	31	21	16	25	12	8	5	2	3	0	0
Share tenants	21	16	5	23.8	3	5	1	1	1	0	1	2	0	2	0
Cropper-wage	26	21	5	19.2	8	2	1	4	0	4	0	2	0	0	0
Wage workers	20	15	5	25.0	1	4	3	3	2	1	0	0	1	0	0
Total	231	175	56	24.2	43	32	21	33	15	13	6	6	4	2	0

Source: Sample 76 plantations, Delta study.

¹Grade reached in 1940.

THE ECONOMICS OF PLANTATION OPERATION IN THE DELTA

It is difficult either to prove or to disprove the economic advantages of the plantation as compared with the so-called family-sized farm. Each has its advantages at different times, in different places, and under varying conditions. The difficulty of assembling comparable data makes a comparison an almost hopeless task.

The fact that the plantation system that emerged following the Civil War has not only survived but has grown in importance as the Delta has been more fully developed, is indicative of its adaptation to time, place, and prevailing institutional arrangements. It appears that the same forces that brought the plantation into existence continue to sustain it, and that its continued existence in the Delta area is not due merely to forces of inertia that tend to keep established institutions in existence as long as they continue to be self-supporting.

Some appraisal of the plantation system may be had from objective data and logical deduction with reference to its effective utilization of the factors of production and as to its more general economic and social implications.

Management

The plantation unit is large enough to attract and to demand for successful operation a high level of managerial ability. Those without the requisite ability to handle the intricate and detailed problems of farm planning and operation, credit, and labor are eliminated through bankruptcy.

There are a number of operational advantages associated with the plantation because of its size. The plantation operator is often able to drain, improve, and bring into production land that would otherwise remain submarginal. This is made possible through access to necessary capital and also because the larger units can handle secondary drainage problems over rather wide areas much more easily than can smaller operating units. Also, the most improved methods of production with the best available machinery and equipment can be efficiently utilized by the plantation unit.

Some of the larger units employ full-time soil specialists with a view of constantly improving and utilizing to the fullest extent each acre of land. Improved seed breeding is also a very profitable part of the plantation program on some of the larger units. The improved quality and increased yields within recent years all over the cotton belt are due in part to improved seed breeding by planters in the Mississippi Delta.

The plantation is at an advantage in the purchase of supplies and equipment and in the sale of commodities. Superior managerial ability and volume of purchases and sales are the chief factors. There is little doubt that the plantation system provides a higher level of managerial ability and utilizes this ability more fully than does the average family-sized farm.

Land and Capital Investment

Approximately 90 percent of the investment in plantations in the Delta area is in land and improvements; the remainder is in machinery and equipment, workstock, feed, and seed.⁹ No effort will be made in this report to demonstrate the superior efficiency of the plantation in terms of higher returns on capital investment. Even if sufficient data were available for comparative purposes in terms of earnings on investment in land and equipment, any conclusions drawn would have to be hedged about with many precautions. The difference in land valuation and productivity, as well as in the overall return to the entire labor force, would be qualifying factors.

It is generally recognized that size of operating plantation unit in the Delta is an important factor in successful operation. A study of plantations in the Delta made in 1940 by the Bureau of Agricultural Economics recognized size as a causal factor in plantation earnings, though difficult to measure apart from other causal factors.¹⁰

There seems to be a definite correlation between the size of operating units and cotton yields per acre in the Delta area. From county Agricultural Adjustment Agency worksheets on all farms in three counties within the Delta, the average yield for the years 1938 to 1940, inclusive, was compiled and related to size of operating unit. These data seem to evidence a correlation between the size of the operating unit and cotton yield per acre. Some of the factors contributing to the superior yields on the larger units may not, however, be inherent in the organization of the larger units. The higher cotton yields on the larger units are due to a number of

Table 10—Relation of size of operating unit to percentage of farm land in crops, and cropland in cotton and average yield of cotton per acre, Mississippi Delta, 1938-1940.

Size range of operating units in crop acreage	Number of operating units	Percent crop-land to farm land	Percent cotton land to cropland	Average yield ¹ per acre 1938-1940
1-100	2,563	56.5	41.7	344.3
101-200	273	62.8	42.2	345.9
201-300	122	63.7	40.8	340.6
301-400	84	70.7	40.8	374.9
401-500	62	68.3	40.9	359.6
501-600	43	68.5	41.0	421.9
601-700	33	64.9	41.1	417.3
701-800	38	69.8	40.5	411.1
801-900	28	73.2	41.4	412.7
901-1000	20	68.3	43.2	452.8
1001-2000	76	69.0	41.4	446.2
2001 and above	28	71.7	42.9	522.9
Totals	3,370			

Source: County Agricultural Adjustment Agency records, Sharkey, Washington, and Tunica counties.

¹Yields expressed in pounds of lint cotton per acre.

⁹Langsford, E. L. and Thobodeaux, B. H., **Plantation Organization and Operation in the Yazoo-Mississippi Delta**, p. 27.

¹⁰Ibid.

factors: (1) superior land and better drainage; (2) more adequate operating capital and equipment; (3) a more efficient combination of the factors of production; (4) superior management; and (5) a wider range for selection on the larger plantations of the soil best adapted to cotton production. See table 10.

On the other hand, in terms of operational and overhead costs, the plantation is generally less flexible than the family-sized farm. In times of depression the latter can more readily adopt a live-at-home program and reduce cash expenses for labor and general overhead.

Labor

Despite the very favorable showing made by the plantation system with reference to efficient management and the utilization of land and capital, the plantation system as it operates at present utilizes poorly the plantation labor force. Heavy demands for labor occur from May until approximately the middle of July, when cultivation and hoeing are in progress, and from late August until the latter part of November, the period during which cotton is usually harvested. During the remainder of the year, the plantation labor force is idle much of the time.

It is not alone the planter that loses from the idleness and unproductiveness of his labor force during much of the year. The labor force also lose from under-employment. The two critical periods of chopping and harvesting, and particularly the latter, definitely limit the cotton acreage that can be handled per family and per worker; the competition between cotton and other crops for the time of the worker during peak labor periods likewise tends to exclude other crops. The need for employing outside labor during chopping and picking periods still further reduces already meager incomes to the regular plantation labor force.

Table 11—Estimates by operators of days worked in crops annually by croppers, tenants and wage workers, Mississippi Delta, 1940

Types of tenure	Average days worked in own crops	Average days worked in operator's crops	Total days worked
Sharecroppers	126.3	44.4	170.7
Share tenants	122.3	64.2	186.5
Wage workers		168.4	168.4

Source: Sample 76 plantations.

Table 12—Average total days worked, as reported by croppers, tenants, and wage workers, Mississippi Delta, 1940

Type of tenure	Average days worked in own crop	Average days worked in operator's crop	All days worked off farm	Total average days worked
Sharecroppers ¹	147	22	2	171
Share tenants	162	8	0	170
Cropper-wage	53	131	1	185
Wage workers		210	1.25	211

Source: Sample 76 plantations, Delta study.

¹The combination workers were regarded as sharecroppers in the estimates made by the landlords.

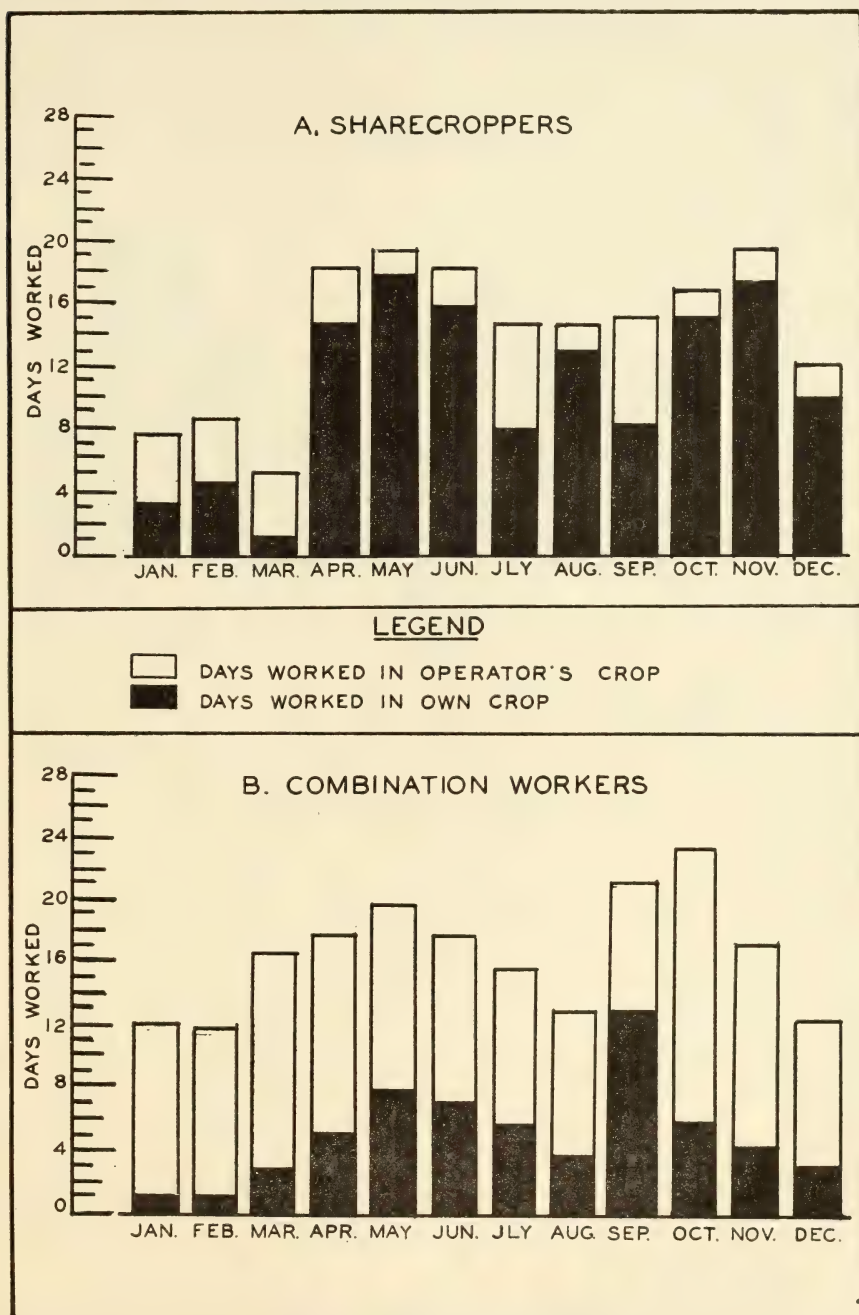


Figure 4. Days worked by family heads, sharecroppers, combination workers (cropper-wage), share tenants, and wage workers each month in own and in operator's crop, Mississippi Delta, 1940.

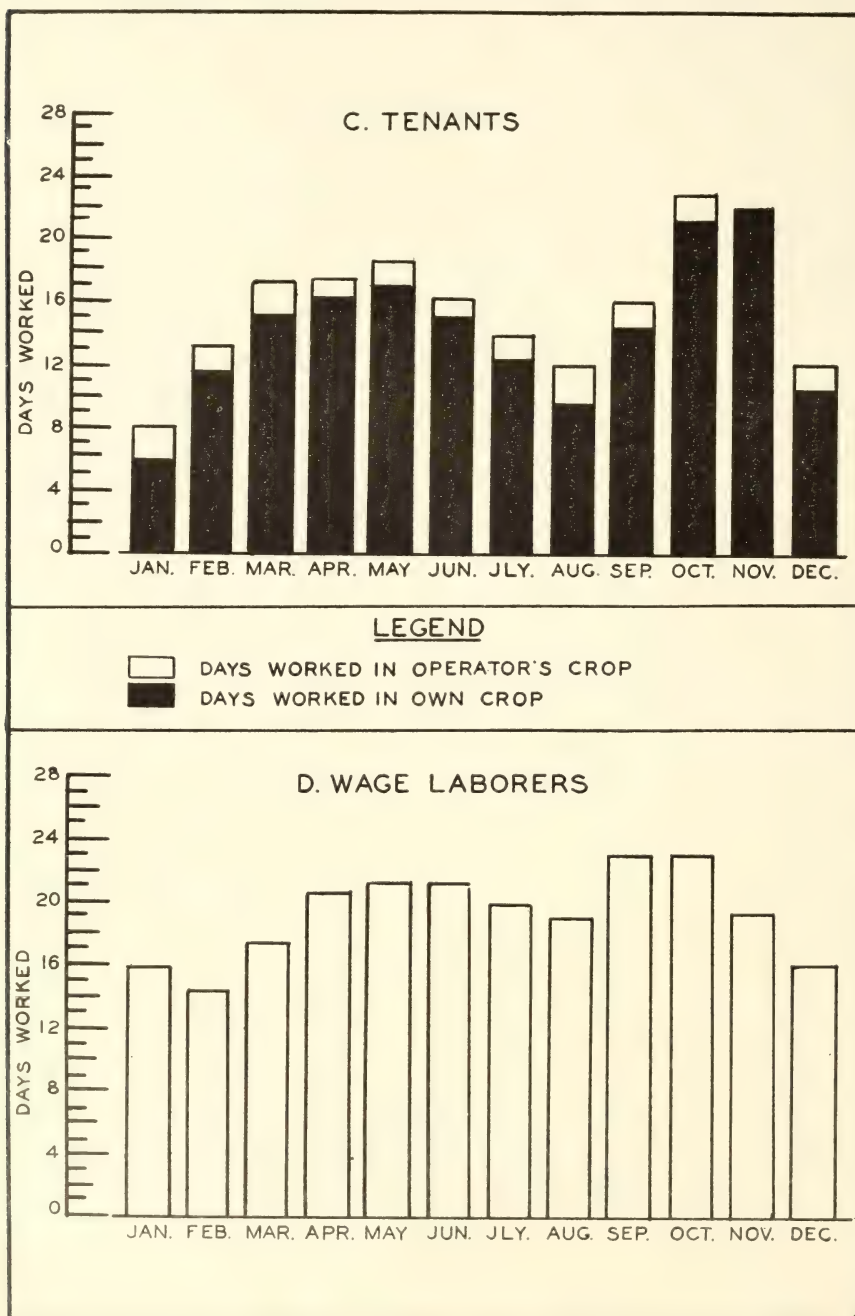


Figure 4. (continued) Days worked by family heads, sharecroppers, combination workers (cropper-wage), share tenants, and wage workers each month in own and in operator's crop, Mississippi Delta, 1940.

It should be remembered, however, that the single-crop cotton economy generally, regardless of type of farm organization, is responsible for much under-employment. The crucial periods of intensive work and relative unemployment are perhaps more noticeable on plantations than on other types of farms because of the greater emphasis on the production of cotton.

In an effort to get at the days actually worked, operators and members of the plantation labor force were asked to give careful estimates of the number of days worked in 1940. Some answers were based on actual records, but most were estimates. Tables 11 and 12 indicate the estimated number of days worked as reported by operators and plantation labor force, respectively. Naturally, there was some variation in the estimates made by the two groups.

As already indicated, the work on the typical Delta plantation is highly seasonal. There are weeks of virtual idleness during mid-winter and midsummer, followed by periods of intensive work by all members of the family plus seasonal laborers employed to take care of the peak labor load. Figure 4 indicates the distribution by months for all classes of plantation labor. It is obvious that with the exception of a few months during the cropping and harvesting periods all classes of labor are under-employed. As an indication of the seasonality of the days worked as reported by the different groups of the plantation labor force, see charts A, B, C, and D of figure 4.

Low Incomes

The lack of full-time utilization of labor accounts in part for the low incomes to plantation workers. It is difficult to arrive at an exact income figure that reflects the standard of living for the different tenure and labor groups. To arrive at such a figure requires that certain items be evaluated in terms of dollars and cents, when oftentimes such exact standards of measurement are nonexistent. The value of fuel and house rent, for instance, is difficult to appraise, since there are no comparable commercial rates available. Likewise, garden values must be arrived at on the basis of information that is incomplete and inadequate for exact measurement.

Table 13 indicates the income to the various labor groups by source and the total income per family. The net operating income, government payments, and family wage earnings, give a fair indication of the cash income per family for 1940. Out of this sum the amount of "furnish" and other debt obligations for the year must be deducted, which means, of course, that this is not indicative of the actual cash handled by the family during the year.

Home-grown Products

From an examination of the data on milk cows, poultry, hogs, and gardens, it is obvious that not enough emphasis is placed by members of the plantation labor force on the live-at-home program advocated by the Extension Service and other agricultural agencies. Despite the fact that low cash incomes make it impossible for crop-

Table 13—Income by source and total family income to the different labor groups, Mississippi Delta, 1940

Type of tenure	Net operating income ¹	Government payments ²	Family wage income ³	Home-use goods ⁴	Perquisites ⁵	Value of gardens ⁶	Total family income
Sharecroppers	\$219.33	\$ 81.13	\$ 31.06	\$ 95.79	\$28.54	\$26.77	\$482.62
Share tenants	176.91	142.53	46.55	144.86	31.12	26.65	568.62
Cropper-wage	101.64	61.14	161.11	87.86	26.07	25.48	463.30
Wage workers	-14.96		295.97	43.30	21.49	18.86	364.66
Single hands	- 4.50		238.99	6.60	11.61	2.33	255.03

Source: Sample 76 plantations.

¹Net operating income means income derived from sale of crops and livestock products, plus inventory adjustments and less direct expenses incurred in production. Furnish for food and clothing was not considered a direct expense.

²Government payments include both parity and conservation benefit payments.

³Family wage income includes all earnings from wages by head and other members of the family.

⁴Home-use goods include all products produced and consumed in the home, such as pork, poultry, and dairy products, excluding garden products.

⁵Perquisites include house rent, fuel for cooking and heating, and other items not ordinarily included in the tenure arrangements, provided free by the landlord (milk, butter, et cetera).

⁶Garden values include only those items grown in the regular garden plot. Garden values were determined on the following basis: The tenant's estimated value was used as the base. This base was adjusted by the field enumerators after considering the number in the family, number of vegetables grown, size of garden, amount of money spent on garden by tenants, and amount of furnish. These factors were considered subjectively in estimating the final value for each individual garden.

pers, tenants and wage laborers to purchase dairy products, only 47.3 percent of the sharecropper families, 23.1 percent of combination cropper and wage worker families, and 19.4 percent of wage families had a milk cow in 1940. On the other hand, the percentage for tenant families with milk cows ran as high as 88.2 percent. The percentages for hogs, chickens, and gardens were a bit higher than for cows for all labor groups. See table 14.

There was wide variation in individual accomplishments with reference to livestock and home-grown products. A few croppers and tenants not only provided for their own needs but also increased their incomes through sale of butter, milk, eggs, and some garden produce.

Home-grown vegetables, fruits, poultry, and milk and butter run counter to the traditional reliance on cotton not only as the principal cash income crop but also as the almost exclusive source of income. The furnish system makes such reliance possible. In other words, cotton and furnish have been the chief interest and chief source of income in the Delta, and it is always difficult to get away from established practices and old habits and attitudes.

Mobility and lack of security are no doubt other factors in discouraging plantation labor from providing more of their needs at home. Since livestock and poultry are a great bother at "moving time," those tenants who move every year or two, or who feel insecure, will make little effort to have these things.

Table 14—Number milk cows, hogs, chickens, and gardens by type of tenure, Mississippi Delta, 1940

Type of tenure	Number reporting	Number milk cows				Number hogs				Number chickens			Gardens	
		3 and over				3 and over				20 and over			Yes	No
Sharecroppers	129	68	33	20	8	16	17	19	77	6	77	46	126	3
Share tenants	17	2	8	6	1	0	0	3	14	0	3	14	17	0
Cropper-wage	23	17	3	2	1	12	0	3	8	6	12	5	21	2
Wage workers	36	29	6	0	1	16	7	6	7	7	20	9	18	18

Source: Sample 76 plantations.

There are also physical factors that tend to discourage the keeping of livestock. Most tenants and croppers have only a minimum of crop acreage assigned to them and this for intensive cultivation of row crops, primarily cotton. Hence, there is no place to keep a cow except in a makeshift stall or tied to a stake on the drainage canal, levee, or other small plot. Furthermore, operators oftentimes object to the time taken from regular field work to look after livestock during rush times, just as they object to the injury done to crops by livestock that occasionally get loose.

Many gardens were poor, due to lack of knowledge and interest on the part of the tenants themselves, the lack of an enclosed plot, and the lack of a plot of land adapted to the growing of garden products. To have a good garden on poorly drained buckshot soil, except a few vegetables in early spring, requires more knowledge, skill and determination than most families have. The sandy loam soils, however, are excellent for vegetable production. The variation in soil largely accounts for the wide differences in garden values for individual families. See table 15.

Table 15—The attitudes of landlords towards live-at-home program by labor force, Mississippi Delta, 1940

Items (code)	Tenants				Sharecroppers				Wage Labor			
	1	2	3	4	1	2	3	4	1	2	3	4
Chickens	7	23			14	53	2		15	33		1
Hogs	7	23			14	53	2		15	34		
Milk Cows	6	22	1	1	15	52	1		15	34		
Gardens	6	20	4		8	51	10		13	32	4	
C. F. and V.	7	22	1		15	53	1		15	34		

Source: Sample 76 plantations, Delta study.

Explanation of code:

1. Landlord encourages labor to have designated items.
2. Landlord allows labor to have designated items.
3. Landlord requires labor to have designated items.
4. Landlord prohibits labor to have designated items.

Mobility

The labor turnover for the Delta during each of the 3 years, 1938-1940, inclusive, was comparatively low. The sifting and se-

lective processes that took place between 1930 and 1940, when there was a surplus of labor, had no doubt tended to eliminate from the regular labor force the more unstable and restless and the less efficient type of labor by 1938. The fact that new places were hard for labor to find and that alternative opportunities for making a livelihood were almost nonexistent tended to discourage farm labor from moving.

The labor turnover for the 3-year period averaged about 15 percent. This figure compares with the census report for the State, as a whole, of 18 percent for croppers and tenants January 1, 1939, to January 1, 1940, and 38 percent from January 1, 1939 to March 1, 1940. Table 16 indicates the number and percentage of families for each labor group hired each year. The number and percentage

Table 16—Number and percentage of families leaving and new families employed, Mississippi Delta, 1938-1940

Type of tenure	1940				1939				1938			
	Leave	Percent total	New families	Percent total	Leave	Percent total	New families	Percent total	Leave	Percent total	New families	Percent total
Sharecroppers	169	12.5	226	16.7	184	13.3	218	15.7	223	17.8	214	17.1
Share tenants	19	21.8	15	17.2	22	24.4	23	25.6	11	12.2	9	10.0
Wage workers	39	16.3	40	16.7	58	24.3	60	25.1	46	19.4	47	18.8
Total	227	12.8	281	15.8	264	15.3	301	17.5	280	17.3	270	17.1

Source: Sample 76 plantations.

leaving and the number and percentage of new families hired each year are different, due to the fact that shifts were being made among the different labor groups and to the further fact that some changes were made in the total labor force.

Seventy out of the 129 sharecropper families interviewed in 1940 had not moved within the past five years; and 40 of the families, or 31 percent, had not moved in the last ten years. Somewhat comparable figures apply to the other labor groups. See table 17.

Table 17—The number of families that moved and the number times moved by tenure groups, Mississippi Delta, 1930-1940

Types of tenure	Number reporting	Number times moved 1935-1940				Number times moved 1930-1940					
		3 and over				5 and over					
		0	1	2	3 and over	0	1	2	3	4	5 and over
Sharecroppers	129	70	28	26	5	40	30	28	13	12	6
Share tenants	16	14	1		1	11	1	3	1	0	0
Cropper-wage	23	13	7	2	1	8	6	4	3	2	0
Wage workers	51	34	13	3	1	17	18	9	4	3	0

Source: Sample 76 plantations.

An effort was made to ascertain from tenants and laborers their reasons for making the last move. Sixty-two families out of the 220 included in the sample study had never moved since beginning to work for themselves; 52 did not know why, or at least the reasons were not ascertainable by the enumerators; 47 moved because they thought they could make more elsewhere; 24 moved because of un-

satisfactory relationships with landlord, such as unfair or unsatisfactory settlement, not enough furnish, or difficult working conditions; 17 moved because of family or personal reasons; 6 moved because of intolerable housing conditions; and the remaining 12 for miscellaneous reasons.

In reply to a question as to why some of their tenants moved from year to year, 23 plantation operators thought their labor turnover had been due to family trouble or to restlessness; 12 others made the families move from their plantations because they were unsatisfactory workers or made trouble among other workers; 15 thought that the moves were made because the workers had a feeling that they might do better for themselves elsewhere; 10 did not have any labor to leave; and the other 16 gave miscellaneous reasons or were noncommittal.

When tenants and laborers move in the Delta, it is from one plantation to another. There were few alternative work opportunities anywhere for this type of labor during the decade 1930-1940 and hence most moves were either forced moves or moves motivated by a hope that a different plantation would offer better opportunities in some way.

The average distances of the last move for each of the labor groups were as follows: Sharecroppers 19.2 miles; cropper-wage workers 13 miles; share tenants 15.7 miles; wage workers 21.5 miles. In this connection, it is interesting to note that 24 sharecroppers, 4 cropper-wage workers, 3 share tenants and 21 wage workers had not made a move since they started working apart from the paternal family. The average time worked by each of these groups that had never moved was 19.5 years for the sharecroppers; 9.2 years for cropper-wage workers, 24.3 years for share tenants, and nine years for wage workers. See table 18.

Table 18—Number families having never moved, average age of head, average years of operation, number and average distance for those who have moved at least one time, Mississippi Delta 1940

Type of tenure	Number reporting	Average age of head	Number never moved	Average age never moved	Years of operation	Number have moved	Average distance moved	Number not reporting
Sharecroppers	129	44.8	24	44.8	19.5	101	19.2	4
Share tenants	17	51.4	3	45.3	24.3	12	15.7	2
Cropper-wage	23	38.1	4	28.0	9.2	18	13.0	1
Wage workers	51	35.1	21	28.0	9.0	28	21.5	2

Source: Sample 76 plantations, Delta study.

Figure 5 illustrates the tenure history of 19 family heads selected from an array of the 220 members of the labor force that composed the sample Delta study. The 220 tenure histories were arrayed on the basis of age of the family head and each twelfth history was selected for graphical illustration.

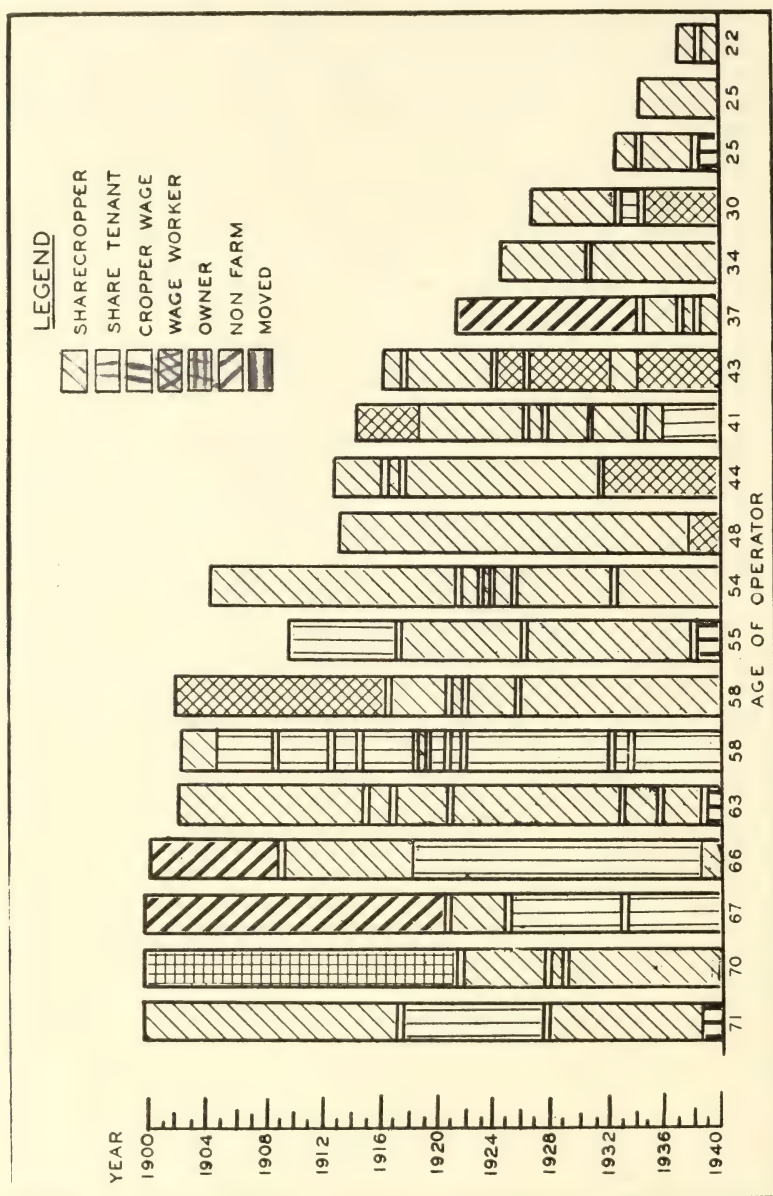


Figure 5. Tenure history of 19 members of plantation labor force, indicating years worked in each tenure classification and times moved, 1900-1940.

As the graduated scale on the left margin of the figure indicates, individual tenure histories were not carried back beyond the year 1900 in any instance. The ages of the family heads are indicated along the base line of the figure, and by relating the cross-hatched bar to the scale of years, the length of time each family head worked in the different tenure classifications can be determined. The frequency of moves is indicated for each individual by a break in the crosshatched bars, each break indicating a move on the part of the family head and his family.

Combination workers were classed as such only for the year 1940. This procedure was necessary because the definition of a combination worker is that of a person who receives one-half or more of total income from wage work on the plantation. Since detailed income information was secured for only the year 1940, all combination workers were classified as croppers for all other years, just as they were classified on the plantations.

Credit

The credit system that is a part of plantation operation exacts high tribute from both management and labor force. There are few plantation operators in the Delta area who, in addition to having long-time debts, do not also depend on credit for operating capital. Because of the risks involved in the year-to-year production of cotton and the uncertainty and fluctuation in price, credit charges have been high. On the plantation there is the additional "furnish" credit system that is an integral part of the plantation economy. So firmly entrenched is the sharecropper credit institution that in some instances croppers who have enough funds to provide for their own needs still insist on having "furnish." "Every crop must stand on its own," is their credo.

Credit may be provided through the issuing of commodities from the plantation commissary, the distributing of cash, or the issuing of coupon books redeemable at the plantation store. A rather high percentage of plantation operators, especially the small and medium-sized ones, at present are providing cash "furnish" rather than commodities through a plantation-owned commissary. This was found to be true in a few instances even where there were plantation commissaries. See table 19 for indications of kinds and frequencies of issuing credit.

It is very difficult to secure accurate information on interest rates as related to "furnish" and other types of credit extended to the plantation labor force. Since the rate of interest was on a flat basis and since other service charges were often incorporated in the interest rates, it is impossible to say just what the average rate of interest was. Also, cash prices as contrasted with credit prices would need to be known before actual interest charges could be calculated.

Table 19—Kind of "furnish" credit and intervals at which provided. Mississippi Delta. 1940

Type of tenure ¹	Number reporting	Kind of Credit			Frequency		
		Cash	Commis- sary	Coupon book	Monthly	Semi-Monthly	Irregular
Sharecroppers	129	54	34	38	93	26	10
Share tenants	17	9	1	7	11	4	2
Cropper-wage	23	12	7	4	20	2	1

Source: Sample 76 plantations from Delta study.

¹The furnish system does not apply to wage workers.

Operators who charged more than 10 percent interest pointed out that the amount above this level was in reality a service charge, designed to help take care of the over-all plantation expenses. The practice of making a per acre charge or a flat charge per family to take care of general overhead expenses was followed in a few instances. The usual charges in these cases were around \$2 per acre, or \$10 to \$12 flat rate per family. See table 20 for interest rates as reported by tenants for "furnish" and other credit items.

Advancement Opportunities

The so-called agricultural ladder is largely nonexistent in the Delta. Large operating units, high land values, the persistence of the caste system, the need for relatively large investments in operating equipment, and the importance of managerial skill, reduce the probability of tenants, croppers, and wage workers ever rising to the status of ownership. This is not to imply that it is never done; but for the farm labor group as a whole, it is difficult.

Table 20—Interest rates as reported paid by tenants for "furnish" and other credit items. Mississippi Delta. 1940

Type of tenure	Number reporting	No interest	8-10	10-15	15-20	20-25	Did not know
Sharecroppers	129	6	43	8	11	44	14
Share tenants	17	0	7	0	5	2	3
Cropper-wage	23	1	11	3	2	2	4

Source: Sample 76 plantations.

There may be some doubt as to whether there is much economic advantage of one tenure class over another. There were slight differences in income among the different labor groups, as indicated by table 13. Tenants seem to have a somewhat higher income than croppers and wage workers. They also had more automobiles, radios, and sewing machines. The status of tenant requires the accumulation of some capital, which no doubt partly accounts for slightly higher incomes. See table 21.

Housing

Housing standards and facilities in the Delta for the farm labor groups are, for the most part, poor. Few modern conveniences were found in the cabins. Running water was not found in any of the houses, and there were only a few sanitary outdoor toilets, such as have been constructed by the Works Project Administration Sanitary Project. Approximately 8 percent of the cabins had been wired

for electricity; 56 percent of the houses were screened. Water was usually secured from shallow pump wells driven into the ground close to the house. In a few instances, however, water had to be carried relatively long distances. See tables 22 and 23.

Table 21—Number and percentage of tenants and laborers owning automobiles, radios, victrolas, and sewing machines, Mississippi Delta, 1940

Type of tenure	Number reporting	Automobiles				Radios			Victrolas			Sewing Machine		
		Yes	No	Percent	Value	Yes	No	Percent	Yes	No	Percent	Yes	No	Percent
Sharecroppers	129	29	100	22.5	113.79	41	88	31.8	23	106	17.8	54	75	41.9
Share tenants	17	8	9	47.1	178.12	10	7	58.8	1	16	5.9	14	3	82.4
Cropper-wage	23	3	20	13.0	180.00	2	21	8.7	3	20	13.0	5	18	21.7
Wage workers	51	8	43	15.7	121.88	16	35	31.4	7	44	13.7	15	36	29.4

Source: Sample 76 plantations, Delta study.

Table 22—Condition and appraisal of plantation labor force houses by tenants, Mississippi Delta, 1940

Type of tenure	Number reporting	Screened		Electricity		Sanitary outdoor toilet		Appraisal of houses			
		Yes	No	Yes	No	Yes	No	Good	Fair	Poor	Dilapidated
Sharecroppers	129	73	55	10	119	8	121	21	50	45	13
Share tenants	17	11	6	1	16	2	15		10	4	3
Cropper-wage	23	16	7	1	22	0	23	4	9	7	3
Wage workers	51	25	26	6	45	11	40	5	25	20	1

Source: Sample 76 plantations, Delta study.

Table 23—Number of rooms and windows in tenant houses, Mississippi Delta, 1940

Type of tenure ¹	Number reporting	Number of rooms					Number of windows				
		2	3	4	5 and over		1-2	3-5	5-8	9 and over	
Sharecroppers	129	31	45	45	8		7	46	69	7	
Share tenants	17	0	5	9	3		0	5	10	2	
Cropper-wage	23	6	9	4	3		2	8	12	1	
Wage workers	51	26	11	13	1		3	29	16	2	

Source: Sample 76 plantations, Delta study.

¹Average number of persons in families: Cropper 4.3, share tenant 3.8, cropper-wage 4.2, wage worker 2.9.

Health

Medical service is usually provided for the labor force by arrangement on the part of the plantation operators. The larger plantations retain the services of a plantation doctor on a monthly or annual basis to look after the labor force. The usual practice, however, is for the operator to arrange for a doctor's visitation, or a visit to the doctor's office, when medical service is needed. The operator pays the doctor and charges the cost to the individual worker's account.

Medical costs were usually high, considering the ability of the workers to pay. The cost of a doctor's visitation was often as high as \$15.00. Consequently, many of the Negroes resorted to patent medicines to relieve them of their "miserias." The expenditures for patent medicines were rather generally distributed among the entire labor force. On the other hand, expenditures for professional medical treatment were less well distributed, which means that this

burden was much heavier for those families who had to have professional medical service than the average figures would seem to indicate. See table 24 for indication of expenditures for doctor bills and patent medicines, and of days lost from illness in 1940.

On a few larger plantations there are group health and hospitalization programs, managed by the planters. On none of the plantations falling within the Delta tenure study sample was there such a program, but some operators indicated that consideration was being given to instituting such programs.

Table 24—Total and average expenditures on family basis for doctor bills, patent medicines, and days lost from illness, Mississippi Delta, 1940

Type of tenure	Number reporting	Medical expenditures	Average amount	Patent medicine expenses	Average amount	Total work days lost	Average work days lost
Sharecropper	129	\$933.00	\$ 7.23	\$520.00	\$4.03	822	6.4
Share tenant	17	120.00	7.06	73.00	4.29	149	8.8
Cropper-wage ¹	23	372.00	16.17	88.00	3.83	203	8.8
Wage workers	51	286.00	5.61	171.55	3.36	235	4.6

Source: Sample 76 plantations, Delta study.

¹A relatively large hospital bill for one individual in this group accounts for the comparatively high average.

The number of work days lost from illness by all labor groups was relatively low in 1940. The work days lost should be considered, however, as only a rough index of the extent of physical deficiencies. Sickness during those periods of virtual idleness was not included in days lost from work, and general debility due to malnutrition or other chronic disorders, described by the Negroes themselves as the "miseries," was not reflected in actual days lost from field work.

By far, the most important illnesses and losses of time due to illness were attributed to malaria and venereal diseases. Eighty-three percent of all operators stated that one or both of these maladies was the most important cause of illness. There was a wide range of other causes given by the other 17 percent of operators, such as colds and influenza, pneumonia, and childbirth.

Soil Conservation

In the Delta, gully erosion has never been a problem. But drainage, sheet erosion, and soil depletion are problems. The requirements for secondary flood control and drainage have discouraged operations by small proprietors. That the present plantation system can be used effectively to improve soil fertility and greatly increase production has been demonstrated by the sharp increase in per acre production of cotton and other crops within the area since the beginning of the agricultural control program in 1933. The average increase for cotton was 82.5 percent from the seasons 1932-1933 to the seasons 1940-1941. See table 25.

Table 25—Average lint cotton acreage yield two-year periods, 1932-1933 and 1940-1941, and percentage increase, Mississippi Delta

Years	Average yield, lbs.	Years	Average yield, lbs.	Percentage increase
1932-1933	208.47	1940-1941	380.45	82.5

Source: Agricultural Adjustment Agency data for Bolivar, Coahoma, Humphreys, Issaquena, Leflore, Quitman, Sharkey, Sunflower, Tunica, and Washington Counties.

RECENT PLANTATION TRENDS

The plantation labor force includes not only families and individuals who reside on the plantation throughout the crop year, but also seasonal workers, the latter being needed especially for chopping and for picking cotton. Some mechanized plantations, located near towns that afford a convenient supply of labor, depend very largely on such workers. But most operators prefer to have a large number of workers residing on the plantation. Many planters believe that resident labor is more efficient; and most of them do not deem it prudent to depend too largely upon outside labor for which the competition may be great in seasons of peak labor-load.

The regular plantation labor force is composed of sharecroppers, wage workers, cropper-wage workers, and tenants, stated in the order of their relative numbers as found on plantations. The kinds of labor on any plantation are determined by the preference of the individual operator, by physical factors, by proximity to sources of seasonal workers, and by the opportunities to obtain the kinds of labor desired. On the larger plantations there are such specialized wage workers as tractor drivers, blacksmiths, and hostlers.

Regular Labor

Practically all of the plantation operators included in the Delta study stated that from 1935 to 1940 replacements for the regular labor force were made by selection from among those applying in person for work on the plantation. The only exception was found in a few instances where recruitment was made through members of the labor force already on the plantation. In no instance did the plantation operators resort to such devices as newspaper advertisements, distribution of handbills, labor contractors, or solicit the aid of the State Employment Service, in the recruitment of the regular labor force.

Less than half the present regular labor force of the Delta were born there. Only 26.8 percent of heads of families were born within the four sample counties, and only 35.4 percent were born in the Mississippi Delta area. The hill counties of the State contributed 46.8 percent; the four states adjacent to Mississippi, Louisiana, Arkansas, Tennessee, and Alabama, contributed 13.2 percent; and all other states contributed only 4.6 percent. See table 26.

That a high percentage of farm labor was born outside the Delta is due possibly to (a) a comparatively low birth rate for the Delta; (b) an increase in the farm population needed in the area during the past half-century; and (c) population migrations and shifts.

**Table 26—Place of birth of 220 family heads by tenure groups,
Mississippi Delta**

Type of tenure	Total	Percent total Code 1	Percent total Code 2	Percent total Code 3	Percent total Code 4	Percent total Code 5
Sharecroppers	129	24.0	9.3	48.1	13.9	4.7
Share tenants	17	35.3	0.0	47.1	5.9	11.7
Cropper-wage	23	21.7	13.0	43.6	21.7	0.0
Wage workers	51	33.0	8.0	45.0	10.0	4.0
Total	220	26.8	8.6	46.8	13.2	4.6

Source: Sample 76 plantations.

Explanation of code:

1. Four survey counties: Sharkey, Washington, Tunica, and Leflore.
2. Other Delta counties.
3. Mississippi hill counties.
4. States adjacent to Mississippi.
5. Other states.

Paul Foreman, in his population studies of the State, has indicated the comparatively small increase in the Negro population for Mississippi during the half century ending in 1930:

"The native white population grew steadily decade by decade. Its increase in this half century amounted to a 110 percent gain; since 1900 a 56 percent gain. Among the Negroes, however, the fifty-year trend shows only a 56 percent gain; that since 1900, only slightly more than 10 percent."¹

He found that Negro women between ages 20 and 44 in the Delta counties have comparatively fewer children under five years of age than do either white or colored women in the other counties of the State. In view of the comparatively low birth rate and the high migration from the Delta, it is doubtful whether the Negro population would have been maintained in the absence of importation of new workers from the outside.

During the 1920's there was a considerable Negro migration from the Delta to the industrial centers of the Middle West and the East, but Delta planters recruited replacements from the hill counties.

Seasonal Labor

Considerable seasonal labor is employed in the Delta during cotton chopping and picking seasons. Since 50 to 60 percent of the man-hour labor requirements for the production of an acre of cotton is for picking, the regular labor force cannot usually gather the crop before weather damage becomes serious. See table 27 for seasonal labor requirements 1935-1940.

Most of the off-farm seasonal labor in 1939 and 1940 was recruited from local sources. Relief workers, domestic servants, and workers from near-by towns were the principal sources of supply. Trucks were used to haul these workers to the plantations in the mornings and back to their homes at night. Most of these workers came from points in the Delta and from Memphis. Truck operators usually

¹Foreman, Paul Breck. **Mississippi Population Trends** (Doctorial dissertation), p. 2. Vanderbilt University, 1939.

transported the workers to and from the cotton fields at so much per head or per 100 pounds of cotton picked by each individual. Some truck operators supervised the picking, for which they were usually paid 10 cents per hundred pounds of cotton picked by workers under their supervision. A few operators provided their own trucks for transporting seasonal workers.

Some seasonal labor was recruited from farms located within the hill counties of the State. The vegetable area around Crystal Springs and Hazlehurst contributed many workers. Cotton picking in the hill counties is usually completed several weeks earlier than in the Delta; hence some hill pickers go to the Delta for a few weeks' employment after their own cotton is picked. In this way they supplement their own low farm incomes and fill the need for seasonal labor in the Delta.

Table 27—Percentage of cotton acres chopped and percentage of total cotton picked by off-farm seasonal labor, Mississippi Delta, 1935-1940

Operation	1935	1936	1937	1938	1939	1940
Chopped	5.6	6.1	5.7	5.8	4.9	3.8
Picked	19.7	20.3	21.1	18.4	17.4	14.4

Source: Sample 76 plantations.

Contractual Relations

The contract between the plantation operator and his labor force is not usually set out in writing; nearly all agreements are oral and informal. Under the prevailing system of plantation operation and management, the usual explanations for not having written contracts are these: (1) a written agreement with a cropper who has little or no property is an unilateral contract binding on the operator but not the cropper; (2) a cropper is in reality, and under the law, an employee who is paid partly in kind, hence a landlord-tenant formal contractual relationship does not fit the case; (3) under the plantation system where the tenant and cropper are under the control and direction of the plantation operator, a contract is not needed to (a) conserve the soil and other farm resources or (b) insure the practice of good husbandry. It is alleged that such an instrument in many instances brings about suspicion and uneasiness on the part of the labor force and tends to work against rather than for a more harmonious relationship.

These arguments are countered by the usual observations: (1) that written contracts are necessary to a feeling of security and stability on the part of tenants and croppers; (2) that if the plantation labor force is ever to acquire appreciable holdings in milk cows, hogs, poultry, and home furnishings, not only must written contracts come to prevail, but these contracts must be for a period of years, especially where tenants and croppers have proved themselves to be dependable, competent workers; (3) that desirable habits and attitudes can come only with the stability and security of contracts that run for longer than a year; and (4) that such contracts are necessary, in some instances, to protect the labor force from arbitrary and unfair treatment.

Many plantation operators have adopted the practice of reducing the working relationships between management and the labor force to a written memorandum and posting this where it can be inspected by everyone. Such a memorandum is merely a statement of what the management will do and what tenants and croppers are respectively required to do.

Trends in Plantation Organization

During the past decade some changes were taking place in plantation organization and operation that may be significant. Causal forces back of these changes may be grouped into the following broad classifications: (1) operation of government programs; (2) shifts in land use and farm organization; and (3) increased mechanization. These forces are not mutually exclusive but are overlapping and interdependent. Moreover, the forces of action and reaction are manifestly important. These causal factors will now be examined in the order in which they are listed above.

Government Programs

The relative influence of the operation of government programs on the number of farm workers and on the organization of the plantation labor force cannot be demonstrated statistically. There is no way of segregating this factor from many other causal factors that operate jointly with it. There are reasons to believe, however, that the Agricultural Adjustment Agency program has influenced the plantation labor organization in the following ways: (1) by bringing about shifts in land use; (2) by influencing the increased utilization of tractors and other mechanized equipment due to (a) shifts from intensive crops such as cotton to more extensive crops such as grains, hays, livestock, soybeans, and forestry, (b) the need for power equipment to handle soil-conserving and soil-building crops required under the program, and (c) the need for power equipment to cultivate limited acreage more intensively and with less delay; and (3) by distributing payments on the basis of respective shares in the crop.

Shifts in Land Use

There have been significant changes in land use and, consequently, in farm organization, since the advent of the Agricultural Adjustment Agency program. There was an increase in percentage of all farm land in cropland from 68.1 percent in 1930 to 70.2 percent in 1940. The most important change has been a drastic reduction in cotton acreage from 1,416,849 acres in 1930 to 862,589 acres in 1940, or a 39.1 percent decrease. Expressed in still another way, there was a reduction in cotton acreage from 78 percent of all cropland in 1930 to 46.1 percent in 1940. There was, on the other hand, an increase in the percentage of cropland in corn, oats, hay, soybeans, and plowable pasture land. See table 28.

Table 28—Proportion of area in major land use classification, Mississippi Delta, 1900-1940

Land classification	1900	1910	1920	1930	1940
Percent approximate land area in farms	41.8	51.9	55.1	63.4	74.1
Percent farm land in cropland	(1)	(1)	(1)	68.1	70.2
Percent cropland in cotton	(1)	(1)	(1)	78.0	46.1
Percent cropland in corn	(1)	(1)	(1)	10.4	28.2
Percent cropland in oats	(1)	(1)	(1)	.2	4.7
Percent cropland in hay, exclusive of sorghum	(1)	(1)	(1)	3.1	11.8
Percent cropland in soybeans	(1)	(1)	(1)	1.5	12.9
Percent plowable pasture	(1)	(1)	(1)	1.2	3.1

Source: United States Census of Agriculture, 1900-1940

1. Comparable data not available.

There was at the same time some adjustment in livestock operation. The increase in livestock and milk cows was due in part to an increase in commercial livestock operation and in part to an increase in the number of families with one or more milk cows. See table 29.

Table 29—Trend in the number of livestock and poultry in the Delta, 1900-1940

Classification	1900	1910	1920	1930 ²	1940
Hogs	159,372	175,744	169,134	115,544	193,325
Milk cows	21,150	38,260	66,209	24,895	35,572
Cattle, all ages	27,075	80,283	78,827	28,741	53,008
All poultry	822,443	655,613	1,006,384	1,681,191	1,152,510
Families with one or more milk cows	(1)	(1)	(1)	20,171	25,488

Source: United States Census of Agriculture, 1900-1940.

1. Comparable data not available.

²Sharp reduction in numbers for 1930 due to 1927 flood.

The significance of the shift away from cotton acreage to small grains, hay, beans, pastures, and livestock, as related to farm labor organization, lies in the fact that cotton production requires a much

Table 30—Labor-hour requirements per acre for production of different crops. Mississippi Delta¹

Crops	Equipment used ²	Man-hours per acre
Cotton	Tractor, 4-row	132.6
	Mule, 1-row	147.1
	Mule, ½ row	158.2
Corn	Tractor, 4-row	24.8
	Mule, 1-row	33.9
	Mule, ½ row	39.8
Oats	Tractor, combine	6.4
Soybeans, beans	Combine	11.7
Soybeans, hay	Tractor baler	17.3
	Mule baler	22.1
Alfalfa hay	Tractor baler	29.3
	Mule baler	39.3
Lespedeza hay	Pickup baler	21.3
		7.0

¹From **Farm Labor Requirements, Mississippi**, by Paul S. McComas and Frank J. Welch, Mississippi Experiment Station Bulletin No. 387, 1943.

²Total man-hours requirement varies with the type of equipment used.

larger amount of labor than that required for alternative crops. The labor-hour requirement per acre for cotton as compared with other crops of the area is indicated by table 30.

Mechanization

Mule power on the cotton plantation traditionally has been as characteristic of the system as sharecropper labor. In fact, many plantation operators have regarded cotton, Negroes, and mules as "a natural combination."



Figure 6. Broad level acres of alluvial soil are well-adapted to tractor operation.

On the other hand, the broad expanse of level fields in the Delta is ideally suited to the operation of farm power equipment, and increasing numbers of operators are using tractors and mechanized equipment. Though the advent of the Agricultural Adjustment Agency program tended to accelerate the rate of mechanization, the coming of the tractor did not await adjustments growing out of the operation of government programs. Tractors have, in fact, been in operation on Delta plantations since 1915 and possibly longer.¹

According to the 1940 census, 2,939 farms in the 10 Delta counties were using a total of 4,964 tractors. Within those 10 counties were 46.9 percent of the total tractors within the State, and if we include the 9 additional part-Delta counties, 59.6 percent of the State total. From the Delta study of 76 plantations, it was found that the trend towards increased mechanization was rapid from 1935 to 1940. See tables 31 and 32. The ratio of tractors to crop and cotton acres

¹See Lewis E. Long. **Farm Power in the Yazoo-Mississippi Delta.** Mississippi Experiment Station Bulletin No. 295, November, 1931.

was higher on the smaller plantations than on the larger ones. Many small operators were purchasing tractors, despite the fact that they could not in some instances be as fully utilized as on larger operating units. See table 33.

There was not only a sharp increase in the number of combines and other power implements along with an increase in the number of tractors, but there was also a noticeable increase in the size and the adaptability of this equipment to larger as well as more refined operations. At the same time, there was marked improvement in small tractors suitable for the small-farm operation.

Table 31—Number of tractors, and tractors per 100 acres of cropland and cotton land, Mississippi Delta, 1930-1940

Number farms reporting tractors		Number tractors		Percentage increase	Number tractors 100 acres cropland		Number tractors 100 acres cotton land	
1930	1940	1930	1940	1940 over 1930	1930	1940	1930	1940
1,087	2,939	1,492	4,964	232.7	.082	.265	.105	.575

Source: United States Census of Agriculture, 1930-1940.

Table 32—Number of farms reporting tractors and number of tractors, Mississippi Delta, 1935-1940

1935		1936		1937		1938		1939		1940	
Number farms reporting	Number tractors	Number farms reporting	Number tractors	Number farms reporting	Number tractors	Number farms reporting	Number tractors	Number farms reporting	Number tractors	Number farms reporting	Number tractors
38	86	42	97	49	117	53	128	56	141	57	150

Source: Sample 76 plantations, Delta study.

Table 33—Number of tractors per 100 acres of total crop and cotton land by size groups, Mississippi Delta, 1935-1940

Size ¹ groups	1935		1936		1937		1938		1939		1940	
	Crop	Cotton	Crop	Cotton	Crop	Cotton	Crop	Cotton	Crop	Cotton	Crop	Cotton
Large	.2	.4	.2	.4	.2	.4	.3	.7	.3	.7	.3	.8
Small	.2	.5	.2	.5	.3	.5	.4	.9	.4	1.0	.4	1.1
Total	.2	.42	.23	.42	.26	.42	.3	.72	.32	.78	.34	.84

Source: Sample 76 plantations, Delta study.

¹Large farms are 400 acres cropland and above; small farms are 100 acres to 400 acres cropland.

Table 34—Trend in the number of workstock, Mississippi Delta, 1900-1940

Class	1900	1910	Percent change ¹	1920	Percent change ¹	1930	Percent change ¹	1940	Percent change ¹
Horses	17,322	21,078	+21.68	22,225	+5.44	12,627	-43.19	7,194	-43.03
Mules	45,035	46,051	+2.26	72,392	+57.20	86,481	+19.46	70,331	-18.67
Total	62,357	67,129	+7.65	94,617	+40.95	99,108	+4.75	77,525	-21.78

Source: United States Census of Agriculture, 1900-1940.

¹Percentage change has reference to change each decade over immediately preceding decade.

Reduction in Number of Work Animals

There was a decrease in the number of workstock between 1930 and 1940. This decrease was not, however, in proportion to the increase in the number of tractors. The decrease in workstock was,

and may continue to be, slow; this is due to a number of reasons: (1) considerable acreage was released from cotton and could thus be utilized in growing an adequate supply of feed for workstock; (2) there are many operations on the plantation that can still be performed more cheaply and satisfactorily with mules; (3) even though a tractor or two may be purchased for handling more expeditiously certain operations, many plantation operators are disinclined to disturb what they regard as the "natural combination of cotton, Negroes, and mules." See table 34.

Counteracting Forces

The tendency for the labor force and mule operation to be displaced through the adoption of mechanical equipment and reduction in cotton acreage and other adjustments in land-use was partially offset by the following counteracting influences: (1) displaced cotton acreage could be used to grow adequate feed, and hence, there was a tendency for many operators to continue mule operation with home-grown feed from displaced cotton acreage; (2) tractor operation with wage workers made it necessary to rely on uncertain seasonal labor for chopping and picking; (3) cotton picked by seasonal workers is from 1 to 3 grades lower in quality than that picked by croppers and tenants who have an interest in the crop; (4) though cotton acreage has been reduced by approximately 40 percent, per acre yields have increased even more, and since from 50 to 60 percent of the labor requirement for the production of cotton goes into picking, the labor saving is not as great as it might seem to be on the basis of cotton acreage reduction; (5) mechanical operation in many instances was more expensive than operation with mules under conditions of low-priced cotton and cheap labor.

Increase in Farm Ownership

There was an increase in the number of both white and Negro owners in the plantation Delta area between 1930 and 1940. See table 35. This increase was due in part to the operation of the Farm Security Administration farm purchase program; in part to the subdivision of foreclosed plantations after the depression, in their resale; in part to the subdivision of estates; and in part to new-ground development in some sections where small operators were securing a precarious equity in small holdings. According to a report of the Farm Security Administration, a total of 185 white tenants and 128 Negro tenants were assisted to the status of ownership between 1937 and 1940. It is not known just how many small operators, located in new-ground settlements and classified as owner-operators in 1940, may not be able to hold the small equity originally acquired.¹

¹A study made by the Bureau of Agricultural Economics in 1940 found that about one in seven settlers was losing his farm in the new-ground settlement areas after the first year or two of work, and that many others were threatened with such loss. See United States Department of Agriculture Miscellaneous Bulletin No. 442, **New Settlement in the Mississippi Delta**, June, 1941, United States Government Printing Office.

Table 35—Number of farmers who were owners,¹ white, Negro, and total in 1930 and 1940, and percentage increase, Mississippi Delta

White owners			Negro owners			All owners		
1930	1940	Percentage increase	1930	1940	Percentage increase	1930	1940	Percentage increase
2,234	3,781	69.2	1,850	2,310	24.9	4,084	6,091	49.1

Source: Census, 1930 and 1940.

¹Owners include part-owners and those who operate through managers.

Table 36 shows that, although the number of owner-operators increased in the decade, there was a sharp increase, both absolute and relative, in the number and the acreage of large operating units (Census classification). This is due partly to increased acreage of feed crops grown by the operator with wage labor, and partly to increased acreage of cotton grown by wage labor. Data are not available to show whether the average size of owned plantations increased or decreased.

Decrease in Tenancy

Census data indicate that tenancy was on the decline between 1930 and 1940 for the first time in the history of the Delta. See table 37. However, this decline in tenancy, as reflected by the census data, must be carefully considered to understand its implications. Under the plantation system, a decline in the proportion of tenancy does not necessarily mean a weakening of the plantation system. Due to the fact that the census reports as many farm op-

Table 36—Distribution of "farms" and "farm" acreage by size of "farm" groups and percentage changes, Mississippi Delta, 1930-1940

Size of farms (acres)	Number of farms		Percentage change 1940 over 1930	Farm acres		Percentage change 1940 over 1930
	1930	1940		1930	1940	
Under 10	5,322	7,447	+ 39.93	36,908	52,026	+ 40.96
10 to 49	70,867	51,611	- 27.17	1,459,046	962,973	- 34.0
50 to 99	2,322	2,428	+ 4.6	144,953	166,174	+ 14.6
100 to 174	600	1,035	+ 72.5	76,625	136,217	+ 77.77
175 to 259	265	514	+ 94.0	56,393	110,300	+ 95.55
260 to 499	355	767	+116.1	127,297	277,436	+117.94
500 to 999	225	563	+150.2	152,495	388,869	+155.00
1000 and over	116	318	+174.1	229,862	574,081	+149.75
Total	80,072	64,683	- 19.2	2,283,579	2,668,076	+ 16.84

Source: United States Census of Agriculture, 1880-1940.

1. "Farm" used as in census classification.

Table 37—Percentage tenant farms Mississippi Delta, 1880-1940

1880	1890	1900	1910	1920	1930	1940
(1)	83.6	89.8	92.4	94.1	94.9	90.6

Source: United States Census of Agriculture, 1930, 1940.

1. Comparable data not available.

erating units as there are sharecroppers, tenants, and owner operators, the shift of a few large plantation owners from the share basis to a wage basis would change the percentage tenancy data for the

entire area. The evidence indicates that just such a shift did take place.

Increase in Wage Operation

Total farm acreage operated by owners and part-owners (census classification) increased considerably faster than did the number of owners and part-owners from 1930 to 1940. The average size of white-owner farm operating units increased from 167.3 acres in 1930 to 234.6 acres in 1940, or an increase of 40.2 percent. It is thus obvious that acreage in the hands of non-owner operators in 1930 was being operated by the owners in 1940. In other words, owners were operating a much higher percentage of their land on a non-share basis with hired labor and mechanized equipment in 1940 than in 1930.

As a further indication of a shift from a share-basis to a wage-basis operation, there was a decrease in the number of white farm units (census classification), of 13.3 percent from 1930 to 1940, while at the same time there was an increase in the amount of farm land in white-operated farm units (census classification) of 87.5 percent. During the same period the average size of white farm operating units, including those of both owner and tenant operators, increased from 69.3 acres in 1930 to 149.9 acres in 1940, a percentage increase of 116.3 percent.

On the other hand, not only did Negro farm operators (census classification), the principal tenancy group, decrease by 20.3 percent,

Table 38—Farm acreage operated by white and Negro owners and part-owners and percentage changes, Mississippi Delta, 1930-1940

Land operated by white owners and part owners				Land operated by Negro owners and part owners			
				Percentage increase			
1930		1940				1930	
Full	Part	Full	Part	Full	Part	Full	Part
275,789	38,949	677,809	168,851	145.8	333.5	69,153	7,113
109,386	15,022	58.2	11.2				

Source: United States Census of Agriculture, 1930-1940.

Table 39—Number of white and Negro operators¹ and acreage of farm land cultivated by each group and percentage changes, Mississippi Delta, 1930-1940

Operators	Number		Percent change	Farm acreage		Percent change
	1930	1940		1930	1940	
White	12,761	11,062	-13.3	844,325	1,658,115	+87.5
Negro	67,311	53,621	-20.3	1,399,254	1,009,961	-27.8

Source: United States Census of Agriculture, 1930-1940.

¹"Operators" as used by census.

but also the amount of farm land cultivated by this group, including both owners and tenants, decreased by 27.8 percent. Thus the average size Negro operating farm unit decreased from 20.9 acres to 18.8 acres, a 10 percent decrease for all Negro farm operating units. This shift is still more significant when it is remembered that the Negro-owner operating units increased slightly in size during this same period. Hence, the reduction in the size of the tenant-operated

unit was considerably more than the 10 percent reduction indicated above.

The sharp reduction in the number of Negro operators (census classification), together with the still greater reduction in crop acreage to Negro operators, indicates not only that there was a shift toward wage operation but also that combination share and wage operation was gaining in importance at the same time. See tables 38 and 39.

Plantation Labor Force Not Much Changed

Apart from year to year fluctuation in number of workers on sample plantations, there was not much change in total numbers between 1930 and 1940. The total rural-farm population decreased from 287,848 to 287,111; rural-farm whites increased 4,249; Negroes decreased 4,986, or from 82.63 to 81.1 percent of the total. There was at the same time an increase in cropland of approximately 3 percent, together with a decline of about 39 percent in total cotton acreage. The large volume of unemployment during this period no doubt accounts for the retention of the regular labor force, even with mechanization and cotton acreage reduction, in order to meet in large measure seasonal labor needs.

Trends by Tenure Groups

An analysis of census and field data indicates that during the decade 1930-1940 farm labor adjustments affected the various tenancy groups differently. The number of cash renters, for instance, decreased by 55 percent during the decade; whereas the crop acres to cash renters seems to have been that of larger units operated largely with mechanical equipment. In discussing the trend toward increased acreage operated by cash renters, the usual observation was that high rental charges made it necessary to operate larger units on the most rigidly economical basis.

Share tenants were affected most of all by shifts that were taking place. There seems to have been a definite trend toward elimination of share tenants as a class in the Delta area. The number, for instance, shifted from 12,202 in 1930 to 4,127 in 1940, a 66.2 percent decrease. Total crop acreage to this tenancy group decreased by 35.9 percent during the same period. The consensus, as reflected by comments made by plantation owners, was that this type of tenure is not adapted to changed condition under the plantation system. Inadequacy of farm power and equipment needed for intensive cotton farming and the handling of cover crops was the usual reason given.

There was some displacement of sharecroppers during the decade, but the displacement was much less than with the other tenancy types. The number of croppers decreased by 9.4 percent; whereas, the crop acreage to croppers decreased by 21.3 percent. The much higher percentage reduction in crop acres cultivated by

croppers as compared with the reduction of cropper families is another indication that the cropper families are working fewer cotton acres of their own, perhaps more intensively, and depending more and more on wage employment in the operator's crops for supplementary income. See table 40.

Adjustments seem to have affected white croppers more than Negro croppers. There was a 35.4 percent decrease in white croppers as compared with a 5.9 percent decrease in Negro croppers. On the other hand, Negro tenants other than croppers decreased by 71.9 percent as compared with a decrease of white tenants other than croppers by 22.3 percent. See table 42.

Table 40—Numbers and acres in farms by tenure groups with percentage changes, Mississippi Delta, 1930-1940

Types of tenure 1	Number		Percent change	Crop acres		Percent change
	1930	1940		1930	1940	
Cash tenants	7,053	3,117	-55.9	251,005	262,584	+ 4.6
Croppers	56,703	51,348	- 9.4	1,048,063	824,750	-21.3
Other tenants	12,202	4,127	-66.2	317,552	203,555	-35.9
Total all classes	75,988	58,592	-22.9	1,616,620	1,290,889	-20.1

Source: United States Census of Agriculture, 1930-1940.

¹Census classification of tenure used here. This classification is not the same as that used in the Delta study. See definition of terms in introduction of this manuscript.

A comparison of census data with data secured by schedules for the period 1935 to 1940 reveals that shifts and adjustments in tenure status were more rapid from 1930 to 1935 than from 1935 to 1940. The number of sharecroppers actually increased by 4.3 percent from 1935 to 1940 on the sample farms. This compares with .02 percent increase from 1935 to 1940 as reflected by the United States Census. An examination of the labor record for all farms in Sharkey, Tunica, and Washington Counties shows, however, that there was considerable fluctuation in the size of the different labor groups from year to year, even during the last half of the decade. See table 41.

Table 41—Total number sharecroppers and tenant families 3 counties, Mississippi Delta, 1938-1940

Year	Sharecroppers	All other tenants
1938	11,190	1,577
1939	9,474	1,228
1940	11,305	1,322

Source: County Agricultural Adjustment Agency data for Sharkey, Tunica, and Washington Counties.

Cropper System Still Dominant

Despite the fact that during the first half of the decade 1930-1940 there was a sharp decline in the number of croppers and a still greater decline in the number of acres to this group, sharecroppers were still cultivating a little more than 50 percent of the total cotton acre-

age in the period 1938 to 1940, inclusive. Cotton acreage to tenants other than croppers during this period was declining rather sharply, and cotton acreage worked by family and wage workers was on the increase. See table 43.

That the sharecropper system is still in high favor in the plantation area is evidenced by the fact that 50 out of the total 76 operators who were asked about preference as to labor organization indicated a preference for sharecropper labor. Twelve additional operators



Figure 7. Recreation on the plantation is often informal and self-made.

out of the 76 expressed a preference for cropper families, but also wanted about an equal number of regular wage families to balance the year-around labor force.

Table 42—Shifts in tenancy groups¹ by race, 1930-1940

	Croppers		Percent change	Tenants		Percent change
	1930	1940		1930	1940	
White	6,833	4,412	—35.4	3,694	2,869	—22.3
Negro	49,870	46,936	— 5.9	15,591	4,375	—71.9

Source: United States Census of Agriculture, 1930-1940.

¹Tenure classification as used by census.

All but nine of those preferring sharecropper labor gave as the reason for such preference the fact that under this system an adequate and dependable labor supply was always available on the plantation and that this type of labor was usually easier to work with and supervise. Nine out of the 76 thought that sharecropper opera-

tion was more profitable to the operator.

Those preferring sharecroppers and wage labor on about an equal basis thought that this combination insured a dependable supply of labor and at the same time made possible more flexibility in operation.

Eleven of the 76 operators preferred wage operation. The most important reason for such preference was that this type of operation was more profitable. Two thought that wage labor was less bothersome or easier to handle.

Thirty-five of the 76 sample farms operated with sharecropper labor exclusively, 5 operated with all-wage labor, and the other 38 farms operated with more than one type of worker as a part of the regular labor force in 1940. See table 44.

Table 43—Cotton acres and percentages of total cultivated by croppers, tenants, and operators, Mississippi Delta, 1938-1940

Year	Cotton acreage and percentages of total worked by Share croppers		Other tenants		Family and Wage ¹	
		percent		Percent		Percent
1938	103,067	50.5	19,256	9.4	81,589	40.1
1939	89,345	51.6	14,475	8.3	69,370	40.2
1940	105,197	50.9	15,637	7.6	85,826	41.5

Source: Data compiled from Agricultural Adjustment Agency records for Sharkey, Tunica, and Washington Counties.

¹Includes acreage cultivated by plantation operator and family as well as hired wage workers.

Table 44—Classification of plantations by types of labor used, Mississippi Delta, 1940

All share croppers	All wage labor	Croppers and wage labor	Croppers, tenants and wage labor	Croppers and tenants	Other combinations
33	5	13	7	13	5

Source: Sample 76 plantations, Delta study.

There was a decided preference on the part of the labor force as a whole for working on a share basis rather than for wages. For instance, 75.5 percent out of the total of 220 family heads expressed a preference for share-work, 20 percent preferred wage work, and no preference was expressed by 4.5 percent.

The reasons given for preferring to operate on share basis rather than for wages were the following, stated in the order of indicated preference: (1) workers on share basis have more privileges and perquisites; (2) they make more money; and (3) share basis operation is easier and provides more work for the entire family.

Those that preferred wage work to share operation gave the following reasons for such preference: (1) more money is made by wage work due to difficulty in getting cotton acreage and prevalence of unsatisfactory settlement practices; (2) less risk is involved; (3) "just liked" wage work better.

Still another pattern of change was that of working on a "through-and-through" basis. Each cropper family was assigned a specific crop acreage, but instead of working this acreage, all workers on the plantation worked in gangs or groups as directed by an overseer. This is a practice, however, that is not entirely new. Some plantations have been operating on this basis over a long period of time.

Emergence of Combination Cropper-Wage Type of Labor

Perhaps one of the most significant changes taking place with reference to the plantation tenancy system is the fact that the term "cropper" has become generic in the sense that it covers a multiplicity of relationship patterns. Out of a total of 142 cropper families selected in the sample it was found that 21 of these families received 50 percent or more of annual incomes from wage work. These families were therefore classified in our sample as combination cropper-wage families. This number does not include many other families who had less than a full quota of cotton acreage and were thus dependent in part on wage employment for supplementary income. In response to a question as to whether they had all the cotton acreage that they wished and that could be handled, 43.5 percent of the combination families wanted more cotton acreage than they had.

Table 45—Trend in labor force by tenure groups. Mississippi Delta. 1935-1940

(1) Type of tenure	1935		1936		1937		1938		1939		1940	
	Number	Percent total	Number	Percent total	Number	Percent total	Number	Percent total	Number	Percent total	Number	Percent total
Sharecroppers	1,308	73.1	1,324	73.5	1,299	73.9	1,253	73.0	1,388	74.5	1,350	74.0
Share tenants	105	5.9	102	5.7	86	4.9	90	5.2	90	4.8	87	4.8
Wage workers	375	21.0	375	20.8	373	21.2	374	21.8	384	20.6	388	21.3
Total	1,788		1,801		1,758		1,717		1,862		1,825	

Source: Sample 76 plantations, Delta study.

1. Number of croppers and renters secured from county Agricultural Adjustment Agency records; number wage workers from operators on sample plantations.

Inputs and Distribution Adjustments

Other consequences of the impact of the operation of government programs, shifts in land-use, and mechanization have been shifts in production contributions and division of crops and income. Certain trends with reference to the inputs and division of the crops under the plantation system were discernable between 1930 and 1940. Some planters, for instance, were shifting from the 50-50 share basis to a 60-40 share basis. Under this system all seed, fertilizer, and poison are paid for by the operator and he receives 60 percent of the crops and 60 percent of the government soil conservation and parity payments.

This adjustment was explained by the planters in terms of relatively increased production costs on the part of the management and equalization of opportunity for all the croppers. On the larger plantation units not all the land is equally productive. Certain parts of the plantation require much heavier applications of commercial fertilizer to raise the yields to anything like the average yield of the plantation as a whole. Under the old system of 50-50 contributions and equal division of crops, the cropper who happened to be located on the least desirable soils was at a disadvantage. He had to pay one-half of the heavy fertilizer bill on his acres and yet did not receive a greater share of the crop than did the croppers on the better soil. Under the 60-40 plan, the planter or plantation operator pays for all of the fertilizer and in this way the expenses and income are somewhat equalized among the cropper labor force on a plantation unit.

Some planters, instead of shifting to the 60-40 basis, were charging a cash rent for crop acres other than cotton and such cash rent was considerably higher than the crop yields would justify. The arrangement was obviously being used to modify or adjust the 50-50 share basis in the distribution of crops.

Other modifications in the traditional arrangements with reference to inputs and division of crops as between landlords and croppers and tenants were taking place. On many plantations, instead of the planter providing the power and equipment as a part of his contributions, mechanical equipment was used to perform certain operations for which the croppers and tenants were charged a fee.

By far the most common type of farm operation performed by the landlords on a service charge basis was that of breaking the land in preparation for planting. A few operators, however, followed through with mechanical planting and in some instances cultivating. Out of a total of 69 plantations with some sharecropper labor, 41 performed some service for croppers with tractors and mechanical equipment on a fee basis; 34 out of this number did seed-bed preparation work; 10 did some planting; and 6 did cultivation work.

Most operators stated that charges for tractor plowing were based on estimated cost of service. In some instances, however, only direct or out-of-pocket cost was considered; in other instances, wear and tear and general depreciation were also considered as elements of cost. There was a rather wide variation in the charges made for tractor service. See table 46.

Table 46—Farm operations performed with power equipment by landlords for croppers and tenants, and charges made for different services, 1940

Sharecroppers				Share tenants			
Type of operation	Per acre charge	Number	Weighted average ¹	Type of operation	Per acre charge	Number	Weighted average ¹
Seed-bed preparation	\$2.00	1	\$.93	Seed-bed preparation	\$1.25	1	\$.94
	1.50	1			1.20	5	
	1.25	1			.75	3	
	1.00	21					
	.75	4					
	.60	1					
	.50	3					
	.30	1					
Planting	.25	1	.87	Planting			.62
	2.00	1			.75	1	
	1.00	4			.50	1	
	.75	1					
Cultivating	.50	4	1.22	Cultivating			2.50
	2.50	1			2.50	1	
	1.50	1					
	1.00	2					
	.85	1					
	.50	1					

Source: Sample 76 plantations, Delta study.

¹Weighted by aggregative method.

SUMMARY AND CONCLUSIONS

This study was designed to provide the basis for a better understanding of the plantation in its varied and complex implications. No effort has been made to formulate a concrete working program for the solution of real or imagined plantation tenure ills. The first important step, however, in any effective program of improvement, is that of objective analysis and careful appraisal of the existing system.

The modern plantation in the southern United States has its roots deep in the traditions and history of its origin and early development. Since political, social, and economic forces have alike been important in its evolution, all these forces are important in the analysis and interpretation of the existing plantation system. The limitations of this study made it impossible, however, to deal with the political and social aspects except by implication.

The general characteristics of the plantation system may be stated in terms of its major requirements: (1) a plentiful supply of level fertile land; (2) a docile, low-status labor supply; (3) detailed management involving social and economic supervision; and (4) a staple crop that can be grown under a well-established routine. However, many of the distinctive features that differentiate the plantation from other types of large-scale farm organization can be understood only in terms of a knowledge of the detailed operation of the plantation as such.

The plantation is important in Mississippi in terms of land and people involved in its operation. Even though the plantation type of farm organization is not as important in the Brown Loam and Black Prairie areas as formerly, where it was once predominant, plantation units are still found within these areas in significant numbers. A few plantations are also found scattered in the other hill areas of the State. The real concentrated super-plantation area of the country is in the Mississippi Delta. Here 83 percent of all farm land is in the hands of planters, 81 percent of the cotton acreage is under the plantation system, 91 percent of the "farms" are tenant units, and more than 90 percent of the plantation labor force is Negro.

Under certain conditions plantations have advantages over family-sized farms. In addition to certain general over-all advantages that accrue to the plantation because of size, there is a definite correlation of cotton yields with size. Yields, for instance, on the larger units over the period 1938-1940, were a little more than 100 pounds of lint cotton per acre in excess of average yields on the smaller units. This should not be interpreted to prove, however, that the plantation is more efficient in terms of per acre production than smaller farm units. Important factors other than the type of farm organization were present.

The following advantages are usually associated with the plantation organization: (1) superior management; (2) utilization of scientific and technical assistance; (3) the favorable purchase and sale of commodities on a large scale; (4) the operation of auxiliary services, such as gins, commissaries, machine-shops; (5) easier access to operating capital; (6) a fuller utilization of mechanized equipment; (7) more efficient combination of the factors of production; (8) less difficulty and expense in the handling of secondary drainage problems; and (9) a wider latitude for selection of soils best adapted to different crops.

On the other hand, the advantage and efficiencies of the plantation do not always reflect themselves in the economic and social well-being of the labor force that makes the system possible. Such deficiencies as the following were found to be prevalent: (1) low incomes; (2) underemployment; (3) high interest charges on "furnish"; (4) poor and inadequate housing; (5) monotonous and deficient diets; (6) poor institutional services; (7) limited educational opportunities; and (8) failure of the system to provide incentives and opportunities for economic advancement.

Certain adjustments were taking place between 1930 and 1940 as a result of (a) the operation of government programs, (b) shifts in land use, and (c) increased mechanization.

The percentage of total cropland planted to cotton decreased from 78 percent in 1930 to 46 percent in 1940. The two-year total average cotton production 1940-1941 for the Delta was 18 percent above the 1932-1933 average despite the fact that during the same period there was 39 percent reduction in harvested cotton acreage. The increase in per acre yield was 82.5 percent. Corn acreage was increased 180.1 percent from 1930 to 1940, and oat acreage threshed increased 3,185 percent during the same period. In 1940 acreage seeded to green manure crops, legumes, and pastures was 39.5 percent of total cotton acreage, or 42.1 percent of all cropland.

There was a definite trend toward larger operating units and mechanized operation. There was a slight increase in the number of owners, and a reduction in tenancy, the latter being due largely to a shift from share to wage operation. There was a very slight reduction in the total plantation labor force, a 66.2 percent decrease in share tenants, a 9 percent decrease in sharecroppers, and a sharp increase in regular wage workers. The number of seasonal wage hands fluctuated with varying weather conditions and the total production of cotton

The constant pressure of excess population on the limited supply of good land greatly complicates the plantation land tenure situation. Undue emphasis on a single cash crop system that requires a large amount of seasonal labor tends to hold the otherwise excess population on the land. Lack of alternative or supplementary employment opportunities makes this possible. Consequently, under-

employment of the labor force during much of the year was an important cause of low incomes. In other words, the problems of excess population, lack of diversification, absence of part-time industrial employment opportunities, high risk involved in the production of cotton, high interest charges on credit, high tariff rates, differential freight rates on products moving out of the South, and general lack of industrial development, are economic factors that affect the plantation tenure system. When improvement is made with reference to these general area deficiencies, it will be much easier to make progress in the improvement in the plantation tenancy system.

In any program designed to reduce the incidence of tenancy within the plantation areas or to improve the system as such, it should be remembered that programs of improvement do not operate within a vacuum. A strong sense of tradition and conservatism is still very much alive in the plantation area. It, furthermore, cannot be too strongly emphasized that the plantation tenancy system has racial and political as well as economic implications. It is the partially accepted solution to a race problem that has existed since the Civil War. Elaborate codes, now largely receded from consciousness, have grown up to rule relations between the white and Negro races.

Anything that tends to disturb these relationships engenders determined and resourceful opposition.

There are also difficulties as to the labor force itself. The Negro was violently delivered in 1862 into a freedom for which he was unprepared. After he was thus delivered and after the first fine frenzy of reconstruction was over, he was left largely to his own devices to work out his own destiny. The sharecropper system that has now been in operation for more than 70 years has stamped its imprint on him. Preparing millions of these landless people for a type of tenure different from that which has existed since slavery is an enormous, complex problem. Such an undertaking is obviously a problem for the years.

Finally, it may be safely assumed that, unless public policy decrees otherwise, the organization and operation of the plantation system in the future as in the past will be determined largely by whatever appears to be economically advantageous. The broader social implications of the system, whether in the abstract or in the form of immediate concrete problems, will be of secondary importance as causal factors in shaping the future course of the plantation system. The profit motive is still the basis for its existence. On the other hand, continued government subsidy and support of agriculture by the Federal Government is likely to be accompanied by increasing interest in the incidence of such programs on land tenure, tenancy arrangements, and relationships.

Tests of
Cotton Varieties
in the
Hill Section of Mississippi
1942

By

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E. B. FERRIS, Superintendent,
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South Mississippi Branch Station, Poplarville

MISSISSIPPI STATE COLLEGE
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CLARENCE DORMAN, Director

STATE COLLEGE

MISSISSIPPI

Cotton Variety Tests, 1942

By J. F. O'KELLY, Head, Agronomy Department

T. E. ASHLEY, and E. B. FERRIS

Cotton producing conditions in Mississippi, considering the State as a whole, were excellent in 1942. In a few places germination was slow because of inadequate soil moisture. In still other cases there was a little too much moisture at and following planting. Here and there,

a slight labor shortage delayed the cleaning of weeds from the young cotton plants. On the whole, however, production and harvesting conditions were good.

Holly Springs

Rainfall was moderate in April and rather light in the first half of May.

Table 1. Cotton varieties, Holly Springs, hill soil, 1942.

		Per acre		Rank in value	Lint data		
		Pounds lint	Total value		Percent- age	Length inches	Bolls per lb. lint
1	Bobshaw 1	789.7	\$178.85	1	37.2	15/16	187
2	Stoneville 2B	737.5	171.75	2	35.5	1	172
3	Hi-Bred	735.2	149.20	10	42.5	13/16	146
4	Coker 100 Wilt	732.0	166.87	3	36.9	31/32	175
5	Deltapine 12	723.5	163.53	5	39.8	1	192
6	Deltapine 14	669.6	151.35	8	39.8	1	178
7	Delfos 651	665.1	166.37	4	36.2	1 3/32	196
8	Acala 892	659.4	147.70	11	38.8	15/16	146
9	Miller	652.9	147.66	12	37.4	15/16	154
10	Stoneville 5A	635.5	147.48	13	37.0	31/32	189
11	Coker 100-5	621.2	152.45	7	39.2	1 3/32	177
12	Cleveland 54	621.6	134.17	15	37.6	7/8	178
13	Delfos 531C	615.0	154.71	6	35.4	1 3/32	207
14	Delfos 3506	600.2	147.47	14	35.6	1 1/16	210
15	Bobshaw 2	598.5	150.15	9	32.9	1 1/16	195
16	Express 11384	513.8	131.83	16	32.8	1 3/32	219

Table 2. Cotton varieties, Holly Springs, valley soil, 1942.

		Per acre		Rank in value	Lint data		
		Pounds lint	Total value		Percent- age	Length inches	Bolls per lb. lint
1	Miller	733.5	\$171.21	3	35.2	1	183
2	Acala 892	718.4	166.79	6	35.9	1	167
3	Bobshaw 1	705.9	167.15	4	35.0	1 1/32	211
4	Hi-Bred	705.9	150.43	15	39.4	7/8	161
5	Cleveland 54	684.6	158.55	9	34.3	15/16	203
6	Coker 100 Wilt	672.0	167.11	5	34.0	1 1/16	200
7	Deltapine 12	663.6	161.46	7	37.0	1 1/16	215
8	Deltapine 14	646.6	160.88	8	37.0	1 3/32	235
9	Stoneville 5A	629.0	155.58	12	34.7	1 1/16	216
10	Stoneville 2B	604.9	154.47	14	33.4	1 3/32	188
11	Coker 100-5	579.6	157.52	10	35.0	1 1/8	206
12	Delfos 651	566.9	183.16	1	32.8	1 7/32	235
13	Delfos 531C	537.6	173.93	2	32.6	1 7/32	236
14	Delfos 3506	534.4	155.59	11	32.3	1 5/32	240
15	Bobshaw 2	522.7	154.98	13	30.0	1 5/32	235
16	Express 11384	443.3	145.84	16	30.2	1 7/32	246

Growth conditions were good later, with slightly more rainfall than at some other locations.

Cotton varieties having a staple of 1-1/8 inches or longer usually produce quite well on the fertile valley soils of the Brown Loam Area. It is wise, however, to be cautious about the use of staple varieties even on these soils of the hill sections because the picking qualities of such varieties are poor, and it is often

difficult to get long cotton ginned properly. Weather-damaged and gin-cut staple cotton is usually hard to sell.

Staple varieties should be used with caution for another reason. Such varieties usually do not resist wilt well and the wilt disease is usually most abundant on sandy valley soils.

Raymond

Rainfall reached flood proportions at this place about the middle of May and

Table 3. Raymond cotton variety test, valley soil, 1942.

		Per acre		Rank in value	Lint data		
		Pounds lint	Total value		Percent- age	Length inches	Bolls per lb. lint
1	Bobshaw 1	790.6	\$198.88	6	35.4	1 3/32	182
2	Deltapine 12	749.4	184.46	9	38.7	1 3/32	224
3	Deltapine 14	731.1	204.33	4	38.8	1 5/32	210
4	Cleveland 54	679.3	160.77	13	33.5	1	214
5	Coker 100 Wilt	671.9	183.50	10	34.3	1 1/8	207
6	Delfos 651	658.2	220.75	1	33.9	1 1/4	233
7	Stoneville 2B	651.2	201.59	5	33.3	1 3/16	202
8	Miller	650.5	153.44	14	35.5	1 1/32	177
9	Stoneville 5A	638.0	182.93	11	34.5	1 5/32	222
10	Coker 100-5	632.4	211.35	2	34.5	1 1/4	202
11	Delfos 531C	626.8	210.96	3	33.3	1 1/4	229
12	Acala 892	621.4	144.49	15	35.7	1	172
13	Delfos 3506	615.0	198.19	7	33.2	1 7/32	201
14	Hi-Bred	561.0	118.16	16	38.7	27/32	165
15	Bobshaw 2	558.2	164.82	12	30.5	1 5/32	235
16	Express 11384	546.4	185.89	8	31.6	1 1/4	249

Table 4. Raymond cotton variety test, hill soil, 1942.

		Per acre		Rank in value	Lint data		
		Pounds lint	Total value		Percent- age	Length inches	Bolls per lb. lint
1	Deltapine 12	801.5	\$179.00	5	41.8	1	207
2	Coker 100-5	768.8	203.21	1	39.6	1 1/8	199
3	Deltapine 14	761.9	173.14	7	41.1	1 1/32	212
4	Stoneville 2B	758.0	187.63	3	37.8	1 3/32	198
5	Bobshaw 1	718.0	165.70	9	38.6	1 1/32	219
6	Coker 100 Wilt	714.2	165.27	10	38.2	1 1/32	211
7	Cleveland 54	713.2	154.68	14	37.9	29/32	204
8	Hi-Bred	710.4	133.99	16	42.7	25/32	175
9	Delfos 531C	702.6	198.70	2	36.7	1 5/32	233
10	Miller	693.7	156.66	12	37.6	15/16	197
11	Delfos 651	683.3	183.57	4	36.8	1 1/8	224
12	Stoneville 5A	676.8	156.30	13	38.5	1 1/32	223
13	Acala 892	639.5	143.73	15	38.3	15/16	181
14	Bobshaw 2	644.2	176.18	6	34.1	1 1/8	247
15	Express 11384	599.4	172.08	8	34.3	1 5/32	234
16	Delfos 3506	589.6	158.59	11	36.6	1 1/8	231

Table 5. Cotton variety test, Poplarville, 1942.

		Per acre		Rank in value	Lint data		
		Pounds lint	Total value		Percent- age	Length inches	Bolls per lb. lint
1	Coker 100 Wilt	452.6	\$103.23	1	38.4	1	208
2	Deltapine 12	386.4	86.97	3	42.8	1 1/32	230
3	Stoneville 5A	385.5	87.53	2	39.1	1	229
4	Bobshaw 1	349.7	78.58	4	39.0	31/32	232
5	Miller	341.2	76.13	5	39.4	15/16	194
6	Cleveland 54	290.0	62.05	8	38.8	7/8	208
7	Hi-Bred	278.0	55.66	11	44.8	13/16	182
8	Coker 100-5	274.6	67.55	6	38.8	1 3/32	206
9	Stoneville 2B	270.3	67.21	7	37.1	1 3/32	202
10	Acala 892	264.7	59.50	9	38.3	15/16	194
11	Deltapine 14	259.7	58.20	10	43.6	1 1/32	217
12	Delfos 3506	190.1	50.70	12	38.0	1 1/8	249
13	Delfos 531C	178.5	47.69	13	37.7	1 1/8	235
14	Bobshaw 2	175.0	44.58	14	33.7	1 3/32	277
15	Express 11384	155.0	39.43	15	33.9	1 3/32	269
16	Delfos 651	154.7	38.46	16	37.1	1 3/32	249

again in early August. It was adequate at other times.

It will be observed that varieties grown on "valley" soil produced longer staple than the same varieties grown on "hill" soil. This has been evident at other locations also, and for many years. Investigators have learned that the staple length of any given variety will vary largely with the moisture supply during the period of fiber development. The length is affected to a lesser extent by soil fertility and atmospheric temperature. This is another reason why the indiscriminate planting of staple varieties in the hill sections would be unwise.

Poplarville

At this station soil moisture was too low for prompt germination but rainfall increased later, and throughout most of the growing period there was too much moisture for cotton to do its best.

The money values per acre in this test decreased in nearly the same order as the pounds of lint. Varieties leading in yield this year cannot always be expected to do so, but the upper half of the list does contain most of the varieties which will be found dependable here. In other

words, fairly vigorous, somewhat disease-resistant types are best for this area.

State College

These tests were planted late in April but moisture was not sufficient for germination until the latter half of May. During the remainder of the growing season there were only a few showers. An extremely dry period in June and July held the weevil in check and enabled the plants to overcome a part of the handicap of a late start. There were only a few showers during the harvesting period. By the end of November the rainfall to that date was about 20 inches below normal. The greater part of this deficiency had accumulated since March.

The dryness of the season was largely responsible for a few of the more vigorous varieties performing relatively better than in the two preceding seasons when rainfall was excessive. With only a few exceptions the less vigorous types, like the Delfos strains, were forced to the bottom of the lists.

Although none of the varieties included in the wilt test can be classed as highly tolerant to the fusarium fungus and infection was not severe, the results from

this test do indicate in a general way the relative wilt tolerance of these varieties. With a few exceptions, varieties in the upper half of the test are somewhat tolerant while those in the lower half are less so.

If damage by wilt is not severe it may be best to use a variety that is somewhat tolerant and fertilize liberally. If wilt damage is severe it is usually best to use

a crop other than cotton. It has been difficult to produce varieties having a high degree of wilt tolerance and at the same time possess enough other desirable characteristics.

Money values are based on seed at oil mill prices and on lint of middling grade as reported for the various staple lengths during 10 weeks of the Memphis marketing season.

Table 6. Main cotton variety test, State College, 1942.

		Per acre		Rank in value	Lint data		
		Pounds lint	Total value		Percent- age	Length inches	Bolls per lb. lint
1	Deltapine 12	635.2	\$144.17	2	41.3	1 1/32	194
2	Acala 892	625.7	143.48	3	39.6	1 1/32	150
3	Deltapine 14	621.0	146.36	1	42.3	1 1/16	174
4	Cleveland 54	599.8	134.08	7	39.1	15/16	178
5	Hi-Bred	574.6	116.29	14	45.1	27/32	143
6	Coker 100 Wilt	584.4	135.06	6	38.4	1 1/32	183
7	Miller	584.4	131.66	9	38.6	31/32	158
8	Stoneville 2B	571.7	139.48	5	36.6	1 1/16	175
9	Coker 100-5	551.2	131.92	8	39.6	1 1/16	185
10	Stoneville 5A	530.8	123.25	12	37.7	1 1/32	204
11	Bobshaw 1	527.3	121.69	13	38.6	1 1/32	203
12	Delfos 651	520.5	130.57	10	35.8	1 3/32	208
13	Delfos 531C	515.3	139.87	4	35.2	1 1/8	219
14	Delfos 3506	474.2	128.37	11	35.6	1 1/8	222
15	Bobshaw 2	459.0	114.50	15	33.6	1 1/16	218
16	Express 11384	438.0	109.00	16	33.9	1 1/16	228

Table 7. Standard and new varieties, State College, 1942.

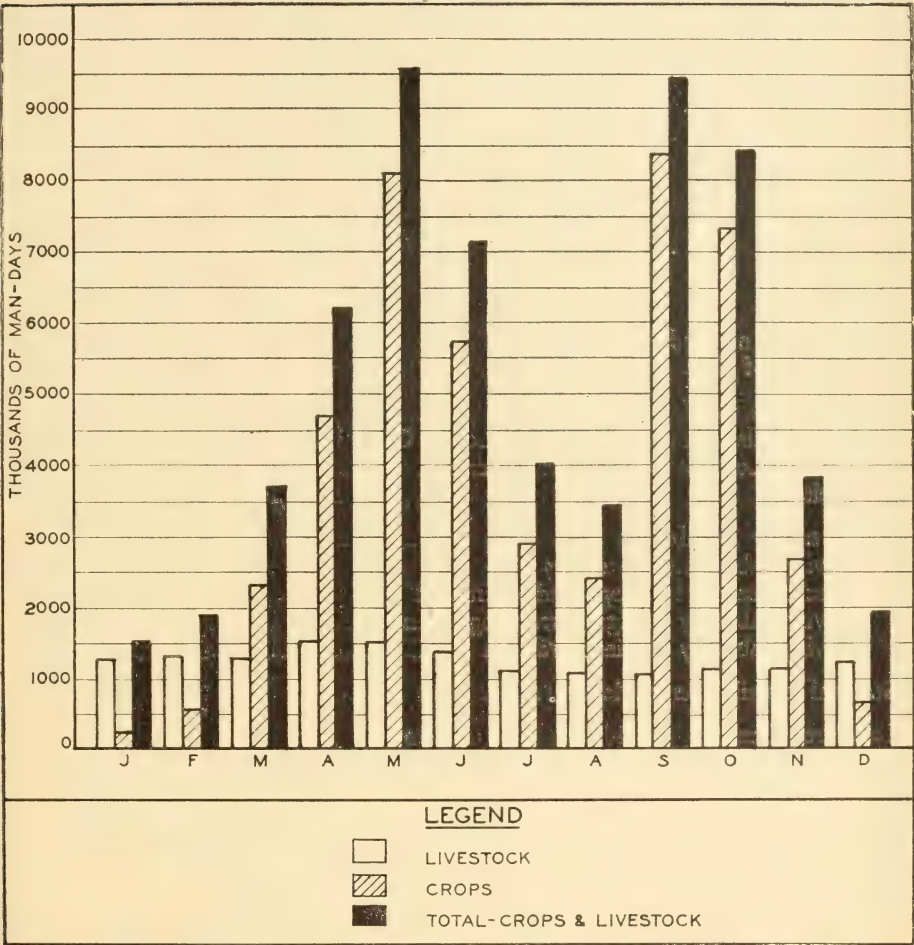
		Per acre		Rank in value	Lint data		
		Pounds lint	Total value		Percent- age	Length inches	Bolls per lb. lint
1	Miller	578.9	\$131.69	6	38.8	1	154
2	Deltapine 14	573.5	135.54	1	41.8	1 1/16	173
3	Stoneville 8275	567.7	132.08	5	37.4	1 1/32	319
4	Coker 100 Wilt	566.0	129.10	8	38.4	1	178
5	Cleveland 54	563.0	125.86	9	39.1	15/16	178
6	Stoneville 2B	545.3	133.14	3	36.5	1 1/16	181
7	Deltapine 12	543.2	123.58	12	40.9	1 1/32	193
8	Delfos 651	535.4	134.49	2	35.6	1 3/32	205
9	Delfos 531C	528.1	132.94	4	35.3	1 3/32	209
10	Stoneville 5A	519.5	120.62	14	37.7	1 1/32	197
11	Stoneville 7428	517.3	118.26	15	40.1	1 1/32	196
12	Bobshaw 1	504.4	116.26	17	38.8	1 1/32	195
13	Delfos 531C-8303	494.9	124.41	10	35.5	1 3/32	213
14	Stoneville 7303	494.6	123.81	11	36.1	1 3/32	192
15	Delfos 6837	487.8	122.80	13	35.3	1 3/32	208
16	Delfos 6466	475.7	131.24	7	32.9	1 1/8	234
17	Bobshaw 16	467.5	115.29	18	35.1	1 1/16	206
18	Express 6637	460.3	117.54	16	33.4	1 3/32	192
19	Bobshaw 12	446.7	109.91	20	35.4	1 1/16	202
20	Delfos 3506	440.2	110.66	19	35.5	1 3/32	396

Table 8. Cotton varieties, wilt infested soil, State College, 1942.

		Per acre		Rank in value	Lint data		
		Pounds lint	Total value		Percent- age	Length inches	Bolls per lb. lint
1	Miller	421.4	\$95.86	1	38.8	1	189
2	Cleveland 54	383.2	85.55	2	39.3	15/16	205
3	Coker 100 Wilt	366.7	84.52	4	38.8	1 1/32	202
4	Stoneville 2B	347.9	84.82	3	36.7	1 1/16	202
5	Stoneville 8275	344.0	83.37	5	37.6	1 1/16	194
6	Stoneville 5A	327.8	79.12	6	38.2	1 1/16	222
7	Stoneville 7428	314.8	72.06	9	39.9	1 1/32	206
8	Bobshaw 1	311.6	71.64	10	39.2	1 1/32	222
9	Deltapine 14	304.3	72.27	8	40.9	1 1/16	215
10	Deltapine 12	297.4	67.90	11	40.3	1 1/32	225
11	Stoneville 7303	295.6	73.79	7	36.5	1 3/32	216
12	Bobshaw 16	246.1	62.60	12	33.9	1 3/32	254
13	Delfos 531C	244.3	61.73	13	34.8	1 3/32	255
14	Bobshaw 12	242.2	61.06	14	35.1	1 3/32	251
15	Delfos 651	236.9	59.73	15	35.1	1 3/32	240
16	Delfos 531C-8303 ..	215.3	54.52	16	34.5	1 3/32	260
17	Express 6637	214.8	53.84	17	33.0	1 1/16	237
18	Delfos 6837	205.8	51.26	19	33.8	1 1/16	274
19	Lelfos 6466	203.5	51.32	18	32.3	1 1/16	278
20	Delfos 3506	186.2	47.23	20	34.3	1 3/32	263



FARM LABOR REQUIREMENTS IN MISSISSIPPI



One grave fault of a predominantly one-crop farm economy is emphasized in figure 2 above, showing man-day labor requirements by months in Mississippi. Note labor peaks, contrasted with periods of labor under-employed. Mechanization and changes in the cropping system are suggested.

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Farm Labor Requirements in Mississippi

By PAUL S. McCOMAS and FRANK J. WELCH*

Manpower on Mississippi farms is of paramount importance at the present time. The agricultural production program in times of emergency as well as during normal times is determined and conditioned in many ways by the quantity and quality of available manpower. To meet the greatly expanded wartime demands for food, vegetable oils, and fiber, it is imperative that individual farm plans and public programs be designed to utilize most effectively the limited amount of labor and power on the farms of Mississippi.

Purpose of Study

The purpose of this report is to provide information on the labor and power requirements by enterprises, on a type-of-farming area basis, and suggest possibilities for saving labor. This information should be of value to agricultural research agencies, to the State War Board in the establishment of production goals, to the State Selective Service in the formulation of policy, and to the Mississippi Extension Service in the administration of the State Farm Labor Mobilization Program, as well as to farmers seeking maximum production with available labor and equipment.

The accompanying data have been assembled with care and the results checked against informed judgment. It should be remembered, however, that labor and power efficiency vary considerably from farm to farm and that averages of this kind must always be applied to cases with discretion and with some appreciation of their limitations. Furthermore, the sum-total of farm labor required in operating

a farm as a going concern cannot be determined exclusively from the enterprise labor and power requirements as indicated here. In the first place, only the more important crop and livestock enterprises were included in the study; and in the second place, the large amount of labor involved in the maintenance and operation of a farm not directly related to individual enterprises was not included. These factors should be kept in mind in any effort to arrive at the over-all sum-total labor requirements for any particular farm unit.

Source of Data

The data presented in this study are based primarily on 900 practice sheets obtained from farmers in 24 Mississippi counties during the period 1941 to 1943 by the staff of the Mississippi Agricultural Experiment Station and the Bureau of Agricultural Economics, U. S. Department of Agriculture. In addition, part of the data presented for the Delta was obtained from U. S. D. A. Technical Bulletin No. 682, "Plantation Organization and Operation in the Yazoo-Mississippi Delta Area," by E. L. Langsford and B. H. Thibodeaux, May 1939. For adequacy and reliability, these data were compared with published data on farm labor requirements in Arkansas, Texas, and Alabama. Enterprise practice schedules were available for sample counties in all type-of-farming areas except the Lower Coastal Plain and the Gulf Coastal (figure 1). With the exception of smaller requirements for cotton picking, due to lower acreage yields, labor requirements in these two areas are about the same as

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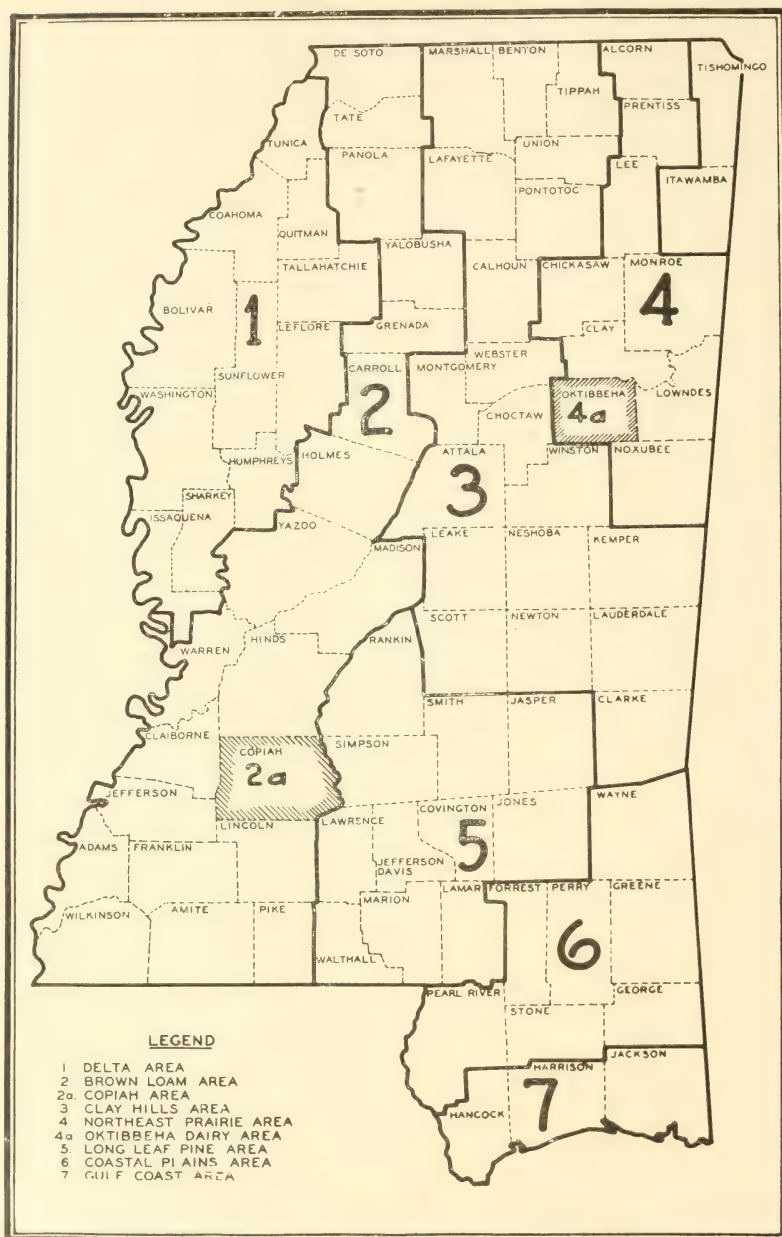


Figure 1. Type of Farming Areas, Mississippi.

the requirements presented for the Long leaf Pine Area. Practice sheets were not obtained for tung and pecan orchards. Therefore, labor requirements for these two enterprises are not presented for any of the areas within the State.

Recent Trends in Labor Requirements

Labor requirements vary widely from farm to farm and from one area to another, largely in accordance with yields, cropping systems, topography, soils, size of farm, and the type of machinery used. Since type-of-farming areas represent delineations on the basis of physical and economic characteristics, labor requirements have been prepared for these areas. In making seasonal distributions, allowance was made for variations in climate for the areas extending north and south. Also, important variations in labor requirements by types and sizes of implements were recognized in areas where mechanization is significant.

To avoid repetition in discussing trends in labor requirements, labor characteristics and mechanization, the State is divided into three general areas largely on the basis of degree of mechanization, size of farm units, and topography. These are: (1) Areas in which nearly all the power is supplied by mules, (2) Areas where mechanized equipment is significant, and (3) Areas in which mechanization is very important. Included in the areas operated largely with mules are the Clay Hills, Longleaf Pine, and Lower Coastal Plain type-of-farming areas. The Brown Loam (including the Copiah Truck Area) and Northeast Prairie (including the Oktibeha Dairy Area) are classified as areas in which mechanization is significant. The Delta is the only area in which tractors provide a large part of total power requirements.

Clay Hills, Longleaf Pine, and Lower Coastal Plain

Labor requirements on farms in the Clay Hills, Longleaf Pine, and Lower Coastal Plain Areas have been affected by

the increase in cotton yield, the reduction in cotton acreage, and the increases in peanuts, feed grains, hay, and pasture. Cotton yields have increased about 32 percent during the last decade in these areas, whereas the cotton acreage was reduced about 40 percent during the same period. For the three areas, per acre labor requirements for cotton picking have increased about 20 percent, whereas total labor requirements for cotton decreased about 34 percent. Corn, hay, and pasture have been substituted for the acreage shifted out of cotton. Since per acre labor requirements for these crops are much less than for cotton, the net result of all these changes has been a decrease of about 20 percent in total labor requirements for all crops during the last decade.

The increase in livestock enterprises during the same period has increased labor requirements considerably and has provided employment for part of the labor diverted from crops. In 1942, labor requirements for all livestock enterprises in the Clay Hills, including workstock, represented about 20 percent of the total labor requirements.

Brown Loam and Northeast Prairie

Labor requirements in the Brown Loam and Northeast Prairie have been affected by the same trends that have been operating in the other hill areas and in the Delta. Cotton yields have increased about 50 percent in the Brown Loam and 30 percent in the Northeast Prairie during the last decade, whereas feed crops and livestock enterprises have been expanded considerably. Off-setting factors include a substantial reduction in the percentage of cropland in cotton, increased mechanization on the larger farms, and an increase in enterprises with small labor requirements. In addition, the increase in livestock has provided a better distribution of labor demands, more employment during winter months, and a better balanced system of farming on the cotton-livestock farms.

Labor requirements per acre of cotton have increased considerably, although not in proportion to the increase in yield. Per acre labor requirements for picking increased from 39 hours to 53 hours in the Brown Loam, or by about 36 percent. The comparable increase for the Northeast Prairie is 15 percent. Thus, the net increase in total labor requirements per acre of cotton has been about 13 percent for the Brown Loam and 5 percent for the Northeast Prairie. Even so, the reduction in cotton acreage and the increase in crops with small labor requirements has resulted in a reduction in total labor requirements for all crops of about 18 percent for the Brown Loam and 23 percent for the Northeast Prairie. Some of the labor was absorbed by reducing the cotton acreage per family and by employing the workers in the production of a larger acreage of feed crops and more livestock. In 1942, labor requirements for all livestock in the Northeast Prairie represented about one-third of total requirements for all enterprises.

Delta

Labor requirements in the Delta have been influenced during the last decade by a number of conflicting trends. The phenomenal increase in cotton yields together with the increase in double-cropping, land clearing, and total crop acreage, has tended to increase labor requirements. On the other hand, the reduction in cotton acreage and the substitution of crops with low labor requirements together with increased mechanization have had the effect of reducing total labor requirements. The net result of all these changes has been a 15 percent reduction in total labor requirements for all crops.

Prior to the introduction of the Agricultural Adjustment Agency program, about 75 percent of the Delta cropland was planted in cotton, as compared to about 43 percent in 1943. As a result of this shift, a few cropper and wage families were displaced but most of the labor

was absorbed in the production of other crops and through a reduction in the number of cotton acres worked per family. The increase in feed grains, livestock, and hay has tended to provide a somewhat better seasonal distribution of labor and a balanced farming system.

Associated with the shift in the use of cropland was an increase in the use of winter legumes and soybeans for green manure crops, as well as a rapid increase in the per acre application of nitrogenous fertilizer. As a result of these practices along with the improvement in cotton varieties and the retirement of the poorest cropland, per acre yields of cotton for 1937 to 1941 were about 80 percent larger than those obtained during the 5 years prior to the introduction of the Agricultural Adjustment Agency program.

Since the labor required for picking 100 pounds of seed cotton decreased somewhat as yields increased, the per acre labor requirements for picking cotton have not increased entirely in proportion to yield. Taking all these factors into consideration, it is estimated that average per acre labor requirements for cotton picking, weighing, and hauling have increased from about 57 hours for the period 1928 to 1933 to about 85 hours for the 5 years 1937 to 1941, or by about 50 percent. The net result as reflected in the total labor requirements for cotton picking in the Delta is an estimated decrease of about 5 percent, whereas total labor requirements for cotton decreased 21 percent.

Total labor requirements for all crops have been reduced about 15 percent, but due to the very small decline in peak labor requirements during the cotton picking season the number of families required to harvest the cotton crop has not changed appreciably.

Possibilities for Saving Labor

There are a number of possibilities for saving labor through mechanization, substitution of enterprises, and by use of efficient cultural practices. The efficiency

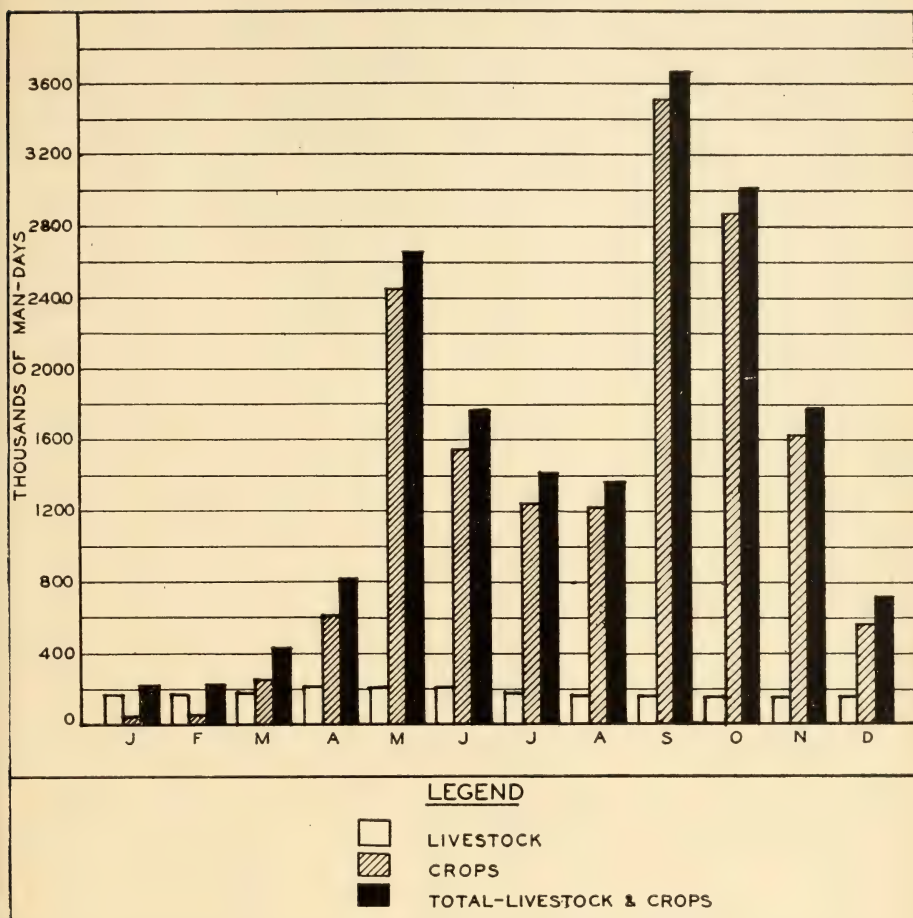
DELTA AREA

Figure 3. Total man-day labor requirements by months for regular crop and livestock enterprises, and for these two combined, based on crop acreage and livestock numbers, 1942, Delta Area.

of machine operations varies according to topography, soil, size of farm, and size of field, as well as by kind of crop and type of farm. Since type-of-farming areas are delineated on the basis of these physical and economic characteristics, possibilities for saving labor are much greater in some areas than in others.

Major possibilities for saving labor within any area are:

(1) Substitution of crops with low labor requirements for those with high

labor requirements and use of crops that give more uniform seasonal labor requirements.

(2) Use of 1-row mule equipment in place of 1/2-row equipment on farms using mules for power.

(3) Greater use of tractors, tractor equipment, combines, power balers, rotary hoes, cotton pickers, and other labor saving machines.

(4) Use of more labor saving practices such as cross cultivation, staggered plant-

ings, early and late maturing varieties, and grazing-off crops with livestock.

Saving Labor With Machines

Opportunities for saving labor through wider use of machinery will be somewhat limited until more steel is allotted to manufacturers of farm machinery. With an adequate supply of farm machinery, farmers in areas best adapted to mechanization could efficiently replace a large portion of their labor losses. Moreover, if food production is to be maintained or increased, it is imperative that a larger supply of machinery and supplies be made available to farmers. Losses of labor have been unevenly distributed from farm to farm and the only possibility of maintaining normal production on the farms with the heaviest reductions in labor is to use more efficient machinery.

The use of mechanized equipment permits timely performance of operations during the critical planting season, relieves mules of much of the heavier work, provides reserve power to use in emergencies, and greatly reduces the number of mules that must be fed all the year just to meet peak power requirements.

Possibilities for saving labor through mechanization are greatest in the Delta because of the level topography, large holdings, large fields, and long straight rows. In this area tractors are already nearly as important as mules in providing the power requirements.

In the hill areas, tractors and tractor equipment have been increasing rapidly on the larger farms and in areas where topography and size of field are suitable. In 1942, using reports of County War

BROWN LOAM AREA

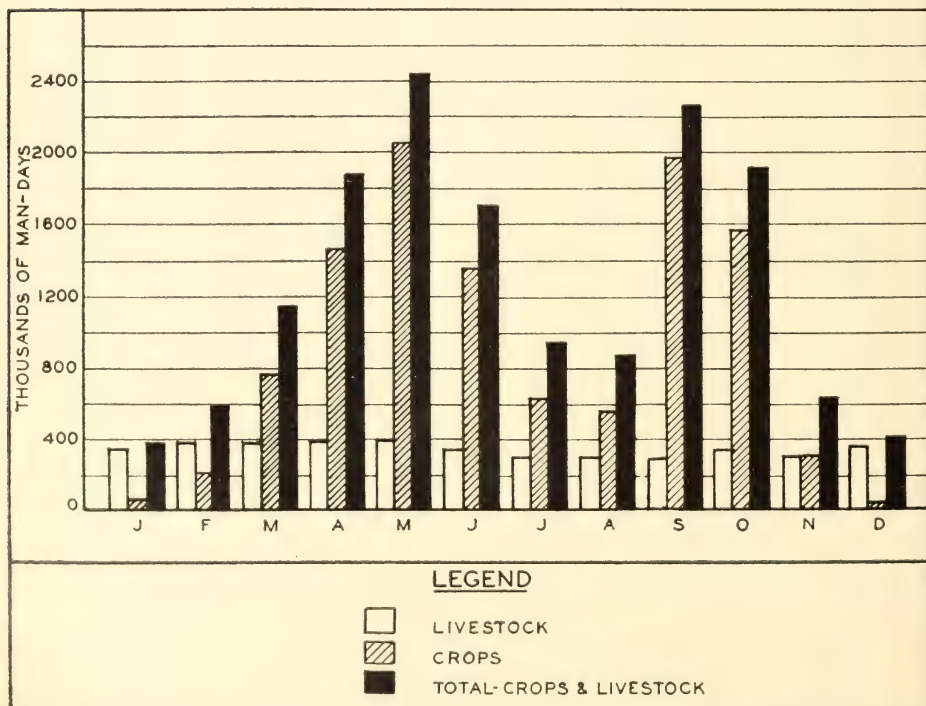


Figure 4. Total man-day labor requirements by months for regular crop and livestock enterprises, and for these two combined, based on crop acreage and livestock numbers, 1942, Brown Loam Area.

Table 1. Man labor and power used per acre of crops and per unit of livestock: Delta Area, Mississippi.^{1/}

Item	Total hours			Distribution of man-hours by months												Normal yields ^{2/}
	Man	Mule	Tra.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Crops: Mule equipment																
Cotton ½-row cultivation.....	158.2	51.3	—	.4	.4	1.1	4.4	23.7	18.5	16.8	11.0	36.5	25.5	14.1	5.8	425 lbs.
Cotton 1-row cultivation.....	147.1	53.4	—	.4	.4	1.1	4.4	20.4	14.6	12.9	11.0	36.5	25.5	14.1	5.8	425 lbs.
Corn ½-row cultivation.....	39.8	37.6	—	.4	.6	3.2	8.7	12.4	2.9	—	—	—	10.0	.4	1.2	22 bu.
Corn 1-row cultivation.....	33.9	37.7	—	.4	.6	3.2	7.1	9.6	1.4	—	—	—	10.0	.4	1.2	22 bu.
Soybeans for beans																
(1-row cultivation)	18.2	28.8	—	.4	—	1.0	2.0	3.4	3.6	3.6	—	.7	1.3	1.0	1.2	18 bu.
Soybean hay, baled	22.1	42.9	—	.4	—	—	—	5.7	—	—	14.4	—	—	.4	1.2	1½ tons
Soybean hay, loose	20.1	41.6	—	—	—	—	—	5.7	—	—	12.4	—	—	.4	1.2	1½ tons
Alfalfa, baled	39.3	51.3	—	—	—	—	—	9.1	9.1	9.1	—	10.0	2.0	—	—	2½ tons
Alfalfa, loose	35.3	48.6	—	—	—	—	—	8.1	8.1	8.1	—	9.0	2.0	—	—	2½ tons
Lespedeza hay	7.0	6.0	1.0	—	.1	.5	.2	—	—	1.1	3.5	1.6	—	—	—	1½ tons
Winter legumes	6.8	10.8	—	—	—	—	—	—	—	—	—	—	3.4	3.4	—	—
Tractor equipment																
Cotton 4-row cultivation.....	132.6	—	6.6	.2	.3	1.2	1.9	16.7	11.0	9.2	11.0	36.5	25.5	13.9	5.2	425 lbs.
Corn 4-row cultivation.....	24.8	7.0	4.4	.2	.3	1.4	4.4	7.4	.3	—	—	—	10.0	.2	.6	22 bu.
Oats	6.4	—	4.0	—	—	.4	—	—	3.2	—	—	.7	1.4	.7	—	45 bu.
Soybeans for beans																
(4-row cultivation)	11.7	—	4.6	.2	—	.5	1.0	1.8	2.4	2.4	—	.7	1.3	.8	.6	18 bu.
Winter legumes	3.3	—	2.5	—	—	—	—	—	—	—	—	—	1.7	1.6	—	—
Soybean hay, baled	17.3	6.0	5.3	.2	—	—	—	3.8	—	—	12.5	—	—	.2	.6	1½ tons
Soybean hay, loose	16.3	8.7	4.3	.2	—	—	—	3.8	—	—	11.5	—	—	.2	.6	1½ tons
Alfalfa, baled	29.3	16.0	5.0	—	—	—	—	7.0	7.0	7.0	—	7.2	1.1	—	—	2½ tons
Alfalfa and pick up hay baler	21.3	16.0	11.0	—	—	—	—	5.0	5.0	5.0	—	5.2	1.1	—	—	2½ tons
Alfalfa hay, loose	30.0	26.7	3.0	—	—	—	—	7.2	7.2	7.2	—	7.3	1.1	—	—	2½ tons
Livestock (per head) ^{3/}																
Workstock	57.0	—	—	4.5	4.5	5.0	5.0	5.5	5.5	5.0	4.0	4.5	4.5	4.5	4.5	—
Dairy cows ^{4/}	163.0	—	—	14.0	14.0	14.0	14.0	13.0	13.0	13.0	13.0	13.0	14.0	14.0	14.0	—
Beef cows ^{4/}	28.0	—	—	3.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	—
Sows and litters	30.0	—	—	3.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	—
Chickens (50 hen flock).....	240.0	—	—	16.0	17.0	20.0	32.0	35.0	32.0	18.0	15.0	15.0	13.0	13.0	14.0	—

^{1/}Data from 140 practice sheets obtained in seven counties in 1941 and from U. S. D. A. Technical Bulletin No. 682, May 1939.^{2/}Normal yields represent "expected yields" and are somewhat above the 5-year average for most crops, due to the large increase in use of fertilizers, use of improved varieties, and better cultural practices.^{3/}Labor requirements for livestock are on a per head basis with the exception of chickens.^{4/}Includes labor required for young animals and replacement stock.

Boards on machinery, and workstock numbers as reported by the Bureau of Agricultural Economics, it is estimated that about 10 percent of the total power requirements in hill areas was supplied by tractor. A tractor is estimated to be equal to eight mules in the Delta in the amount of work performed and to six mules in the hill areas.

In all areas, the necessity for keeping resident labor to supply most of the labor requirements for picking and hoeing cotton has been the most important factor in slowing down the trend toward mechanization. Incentives for using labor-saving machinery have been greatly limited because operations subject to mechanization occur largely outside the major peak labor periods; the one important exception is the use of tractor equipment in cultivating row crops. In this case labor is released for hoeing cotton and corn.

Mechanization by Crops and Operations

On the basis of crops, the highest percentage of mechanization at present is on oats, soybeans for grain, hay, and hay seed crops. It is estimated that tractor equipment is used for about 75 percent of the breaking and preparation of land for cotton and corn in the Delta and on about 20 percent of the cotton and corn land in the Brown Loam and Northeast Prairie Areas. In planting and cultivating, the percentage of cotton and corn handled with tractor equipment is much less than for breaking and preparing.

Through the use of tractors and tractor equipment some of the larger operators in the Brown Loam Area have reduced per acre labor requirements on cotton 17 hours or about 13 percent (table 2). Most of this saving is made in the spring and early summer during the period of breaking, preparing, and cultivating.

In the Delta, planters using tractors and 4-row cultivators save about 26 hours of labor per acre of cotton as compared to the use of mules and 1/2-row equip-

ment (table 1). This represents a saving of nearly 16 percent. On those farms and plantations using 1-row mule equipment in cultivating, a shift to 4-row tractor equipment would save about 15 hours per acre or reduce total labor requirements by only about 10 percent (table 1). Since about half of the total requirements for cotton are for picking, any large saving in labor on cotton must come about through the development and use of mechanical pickers.

Mechanical cotton pickers have been used experimentally at the Delta Branch Experiment Station and on a few Delta plantations for a number of years. The machines have been improved considerably in recent years and now compare favorably with hand picking in regard to the percentage of cotton picked. The major difficulty is the reduction in grade that results from machine picking as compared to hand labor.

From an economic standpoint it is a question of weighing the reduction in the value of cotton due to lower grade against the reduction in the cost of picking. The rate that must be paid for cotton pickers is likely to be the most important variable in determining the economic feasibility of these machines during the war period, although improvements in cleaning equipment and artificial defoliation seem to offer possibilities for improving the grade of machine-picked cotton. With an acute labor shortage and extremely high picking rates, mechanical pickers may become economically feasible before the end of the war. On some plantations mechanical pickers may be the only possibility of salvaging all the cotton.

On the basis of performance rates reported for two kinds of mechanical pickers in the Delta, per acre labor requirements for picking would apparently be only about 4 hours per acre as compared to 83 hours with hand labor. Although these machines are more efficient on large level fields, they would nevertheless have

Table 2. Man labor and power used per acre of crops and per unit of livestock: Brown Loam Area, Mississippi.^{1/}

Item	Total hours			Distribution of man-hours by months												Normal yields ^{2/}
	Man	Mule	Tra.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Crops: Mule equipment																
Cotton	130.6	42.0	—	.4	.4	4.8	14.4	20.8	16.8	11.1	9.2	30.8	19.5	2.4	—	285 lbs.
Corn	38.0	36.0	—	—	2.3	6.8	8.7	10.0	4.0	—	—	1.5	3.5	1.2	—	15 bu.
Soybean and cowpea hay	20.8	38.0	—	—	—	—	1.4	5.3	1.2	—	6.2	6.2	.5	—	—	1.2 tons
Peanuts	66.0	36.0	—	—	—	7.5	7.5	8.0	6.4	1.6	—	25.0	—	10.0	—	550 lbs.
Tomatoes (fresh)	192.0	45.0	—	20.2	22.1	35.9	50.3	28.0	29.0	—	—	—	—	.8	5.7	110 bu.
Cabbage (fresh)	115.0	47.0	—	18.5	21.3	10.5	10.0	27.5	—	—	—	—	7.5	10.8	8.9	6 tons
Snap beans (fresh)	120.0	33.0	—	—	6.8	7.3	13.7	55.2	37.0	—	—	—	—	—	—	70 bu.
English peas (fresh)	128.0	32.0	—	—	6.0	32.5	40.0	40.0	—	—	—	—	—	—	9.5	65 bu.
Sweetpotatoes	112.0	48.0	—	—	—	8.5	18.5	24.4	8.6	—	—	9.5	42.5	—	—	100 bu.
Sugarcane sirup	124.3	80.0	—	—	—	14.3	16.3	12.1	10.8	5.8	—	—	30.0	35.0	—	200 gal.
Sorghum sirup	138.0	72.0	—	—	—	5.0	3.4	6.0	8.5	7.1	—	54.0	54.0	—	—	70 gal
Horse and tractor equipment																
Cotton	113.6	.8	8.5	—	.2	2.4	7.7	18.4	14.2	8.8	9.2	30.8	19.5	2.4	—	285 lbs.
Corn	25.2	6.2	5.7	—	.8	2.3	4.6	8.3	3.0	—	—	1.5	3.5	1.2	—	15 bu.
Oats	6.4	.5	3.8	—	.4	.5	—	—	2.2	—	—	.2	2.1	1.0	—	25 bu.
Soybeans for beans	15.1	5.3	5.1	—	—	—	.6	1.2	6.0	3.7	—	—	2.4	1.2	—	10 bu.
Lespedeza hay	10.8	11.0	1.2	—	.4	.4	—	—	.6	—	4.0	5.0	.4	—	—	1 ton
Sorghum silage	60.3	27.5	6.8	—	—	1.6	2.8	5.5	3.1	.5	13.3	33.5	—	—	—	12 tons
Corn silage	48.3	20.3	5.8	—	—	—	2.2	8.3	7.0	10.0	16.8	4.0	—	—	—	7 tons
White clover for seed	5.7	1.2	3.5	—	—	—	—	.9	2.8	.6	—	.4	1.0	—	—	105 lbs.
Lespedeza for seed	7.3	5.6	1.2	—	.4	.3	—	.7	—	—	—	.8	2.5	2.6	—	200 lbs.
Livestock (per head) ^{3/}																
Workstock	80.0	—	—	7.0	7.0	7.0	7.0	7.0	7.0	6.0	6.0	6.0	7.0	6.0	7.0	—
Dairy cows ^{4/}	140.0	—	—	13.0	13.0	13.0	13.0	13.0	11.0	10.0	10.0	10.0	11.0	11.0	12.0	—
Beef cows ^{4/}	12.0	—	—	2.0	2.0	1.0	1.0	.5	.5	5.0	.5	.5	1.0	.5	2.0	—
Sows, gilts and litters	64.0	—	—	5.0	5.0	7.0	6.0	6.0	4.0	4.0	4.0	6.0	7.0	5.0	5.0	—
Sheep	4.8	—	—	1.0	1.0	.2	.2	.2	.2	.2	.2	.2	.2	.2	1.0	—
Chickens (50 hen flock) ..	230.0	—	—	16.0	17.0	19.0	30.0	32.0	30.0	18.0	14.0	14.0	13.0	13.0	14.0	—

^{1/}Data from 220 practice sheets obtained in four Brown Loam counties, 1941 and 1942.^{2/}Normal yields represent "expected yields" and are somewhat above the 5-year average for most crops, due to the large increase in use of fertilizers, use of improved varieties, and better cultural practices.^{3/}Labor requirements for livestock are on a per head basis with the exception of chickens.^{4/}Includes labor required for young animals and replacement stock.

great possibilities in most hill areas if available for custom work. An efficient cotton picker would tremendously increase the output per worker, eliminate most of the harvest labor peak, and provide incentives for greater efficiency in other operations.

Mechanical cotton choppers and rotary hoes are used to a limited extent in the Delta and seem to offer possibilities for reducing labor requirements for hoeing. Mechanical cotton choppers are useful in blocking out the cotton and reducing the time required of hoe hands. Cross cultivation offers possibilities for reducing hand labor requirements on well-drained loam soils. On the heavy soils, flame cultivators for burning off grass and weeds seem to have possibilities for reducing labor requirements for chopping.

Mechanization in the production of corn offers possibilities for saving a large percentage of total labor requirements. Practice sheets collected from farmers for use in this study indicate that it is possible to save about 13 hours per acre on corn in the portions of the Brown Loam Area where physical and economic conditions are suitable for use of tractor equipment (table 2). Comparable figures for the Delta indicate a possible saving of 15 hours per acre or 38 percent of total labor requirements (table 1). However, the saving as compared to 1-row mule equipment amounts to only about 27 percent.

Corn picking machines developed for the Corn Belt appear not to be well adapted to southern conditions. However, potentially there are possibilities for saving a large amount of labor during the critical harvest season by the development of an efficient corn picker for the South.

Oat production for grain is more completely mechanized in Mississippi than any other crop. In the Delta all oat operations are usually handled with tractor equipment; and labor requirements per acre and per bushel of oats, compare fav-

orably with some of the important commercial grain-producing regions. Six-foot combines with auxiliary motors are the most common type of machine used for harvesting oats.

Soybeans for grain is also a highly mechanized crop. All operations are subject to mechanization with the exception of hoeing. It is usually desirable to hoe out the weeds and grass to facilitate combining as well as to increase yields. By completely mechanizing the soybean enterprise it is possible to save about 5 hours per acre or about one-third of the total labor requirements as compared to the use of mule equipment up to harvest time.

Nearly all operations in hay production are subject to mechanization provided the topography and size of field are suitable. Through the use of tractors, side delivery rakes, and pick-up hay balers, it is possible to reduce requirements from one-third to one-half as compared to mule equipment and stationary balers (table 1). The saving that is feasible depends somewhat on the size of field and the type of hay. Alfalfa, lespedeza, and Johnson grass are well adapted to the use of pick-up hay balers or other movable power balers.

In handling loose hay, mechanical hay forks and hay loaders can be used to reduce labor requirements substantially. Seeding lespedeza in oats is a very efficient method of producing hay since the breaking and preparing operations are eliminated. In addition, land adapted to lespedeza will produce more feed units when double cropped with oats than will the same land planted to corn alone. Labor requirements for lespedeza hay are considerably smaller than for most other hay crops (tables 1 to 5).

Saving Labor by Changing the Cropping System

It is possible to save a considerable amount of labor and reduce the cost of hired labor by substituting crops with low labor requirements for crops requir-

Table 3. Man labor and power used per acre of crops and per unit of livestock: Clay Hills Area, Mississippi.^{1/}

Item	Total hours			Distribution of man-hours by months												Normal yields ^{2/}
	Man	Mule	Tra.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Crops: Mule equipment																
Cotton	114.0	41.2	—	.6	.6	2.8	11.8	17.5	15.2	8.8	6.6	26.6	20.7	2.8	—	240 lbs.
Corn	34.4	34.7	—	—	.5	5.0	6.2	8.4	8.1	1.2	—	—	3.5	1.5	—	14 bu.
Peanuts	66.0	36.0	—	—	—	7.5	7.5	8.0	6.4	1.6	—	25.0	—	10.0	—	700 lbs.
Soybean and cowpea hay	23.8	34.0	—	—	1.6	2.4	2.3	4.0	3.5	—	5.0	5.0	—	—	—	1.2 tons
Lespedeza hay	14.6	22.0	—	—	2.0	4.2	—	—	—	—	2.2	6.2	—	—	—	1.0 tons
Oats for hay	16.5	26.0	—	—	—	1.5	—	9.0	—	—	—	—	7.0	3.0	—	1.0 ton
Sorghum forage	18.0	28.0	—	—	—	1.8	2.2	2.0	—	—	4.0	6.0	2.0	—	—	1.8 tons
Livestock (per head) ^{3/}																
Workstock	60.0	—	—	5.0	5.2	5.6	6.4	6.4	6.4	3.8	3.8	4.2	4.5	4.0	4.7	—
Dairy cows ^{4/}	112.0	—	—	10.0	10.0	10.0	10.0	10.0	10.0	8.0	8.0	8.0	8.0	10.0	10.0	—
Beef cows ^{4/}	28.0	—	—	4.0	4.0	3.0	1.5	1.5	1.5	1.5	1.5	1.5	2.5	2.0	3.5	—
Sows and litters	78.0	—	—	6.0	6.0	8.0	8.0	7.0	6.0	5.0	5.0	6.0	8.0	7.0	6.0	—
Chickens (50 hen flock)	240.0	—	—	16.0	17.0	20.0	32.0	32.0	30.0	20.0	15.0	15.0	14.0	14.0	15.0	—

^{1/}Data from 140 practice sheets obtained in eight counties, 1941 and 1942.^{2/}Normal yields represent "expected yields" and are somewhat above the 5-year average for most crops, due to the large increase in use of fertilizers, use of improved varieties, and better cultural practices.^{3/}Labor requirements for livestock are on a per head basis with the exception of chickens.^{4/}Includes labor required for young animals and replacement stock.

Table 4. Man labor and power used per acre of crops and per unit of livestock: Northeast Prairie Area, Mississippi.^{1/}

Item	Total hours			Distribution of man-hours by months												Normal yields ^{2/}
	Man	Mule	Tra.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Crops: Mule equipment																
Cotton	118.0	48.0	—	1.8	1.8	1.2	6.5	22.2	18.8	14.0	5.4	24.2	18.8	2.7	.6	225 lbs.
Corn	43.0	47.0	—	1.0	1.6	3.7	7.7	11.3	7.0	1.0	—	—	5.2	3.5	1.0	14.5 bu.
Soybean hay	25.0	32.0	—	—	—	—	3.2	3.0	1.0	—	7.5	7.5	1.2	1.0	.6	1.2 tons
Peanuts	66.0	36.0	—	—	—	7.5	7.5	8.0	6.4	1.6	—	25.0	—	10.0	—	500 lbs.
Horse and tractor equipment																
Soybean hay	18.0	16.0	2.0	—	—	—	2.2	1.8	.6	—	7.0	5.2	—	0.6	.6	1.2 tons
Lespedeza hay	10.8	13.0	.8	—	1.0	1.0	—	—	.6	—	4.8	3.4	—	—	—	1.0 ton
Johnson grass	18.5	16.0	1.1	—	—	—	—	.6	8.0	5.5	1.2	1.8	1.4	.0	—	10.0 tons
Sorghum silage	49.2	23.4	4.4	—	—	.5	2.9	2.4	3.6	1.0	8.3	10.7	16.8	—	—	2.0 tons
Alfalfa	37.2	22.0	7.8	—	—	—	—	6.0	9.5	8.6	3.7	9.4	—	—	—	1.2 tons
Livestock (per head) ^{3/}																
Workstock	54.0	—	—	4.8	4.8	4.8	5.2	5.2	4.9	4.0	4.0	3.9	4.1	4.1	4.2	—
Dairy cows ^{4/}	144.0	—	—	12.6	12.6	12.2	12.2	12.2	11.8	11.0	11.0	11.2	12.0	12.6	12.6	—
Beef cows ^{4/}	23.0	—	—	2.8	2.8	2.4	1.6	1.4	1.2	1.2	1.2	1.6	1.8	2.2	2.8	—
Sows and gilts ^{4/}	50.0	—	—	4.0	4.0	4.4	4.6	4.6	4.0	3.8	3.8	3.8	4.2	4.4	4.4	—
Ewes ^{4/}	5.4	—	—	1.0	1.0	.6	.2	.2	.2	.2	.2	.2	.2	.4	1.0	—
Chickens (50 hen flock)	260.0	—	—	18.0	19.0	22.0	32.0	35.0	32.0	20.0	16.0	16.0	16.0	16.0	18.0	—

^{1/}Data from 180 practice sheets obtained in three counties, 1943.^{2/}Normal yields represent "expected yields" and are somewhat above the 5-year average for most crops, due to the large increase in use of fertilizers, use of improved varieties, and better cultural practices.^{3/}Labor requirements for livestock are on a per head basis with the exception of chickens.^{4/}Includes labor required for young animals and replacement stock.

ing a large amount of hand labor. Furthermore, by using a combination of crops that do not compete directly for labor during peak periods, it is possible to spread the labor requirements more uniformly over the crop season and utilize resident labor to better advantage.

There are a number of crop substitutions that will save labor and at the same time expand production of vital war crops. The substitution of oats for corn reduces total labor requirements, increases total feed production (if oats are followed by a hay crop), and reduces the peak labor requirements during the fall harvest season. Oats are harvested in June during the secondary spring labor peak, whereas corn piles up labor requirements during the cotton picking season. Substitution of soybeans for corn and of pasture for hay and corn would also reduce labor requirements. The substitution of peanuts for cotton in hill areas

and of soybeans for cotton in the Delta would save labor, although such substitutions would not be economically feasible on many farms except in case of an extreme labor shortage or much higher prices for vegetable oil crops.

Saving Labor by Efficient Practices

There are a number of practices that can be used to eliminate a considerable amount of labor without materially reducing production. For example, livestock can be used for grazing off corn, soybeans, velvetbeans, sargrain, peanuts, and small grains. In addition to the saving of harvest labor there is a substantial saving in the labor required for feeding. Electric fences can be efficiently used to fence off crops for harvesting with livestock. In portions of the Brown Loam and Northeast Prairie Areas, improved permanent pasture may be substituted to a considerable extent for corn

NORTHEAST PRAIRIE AREA

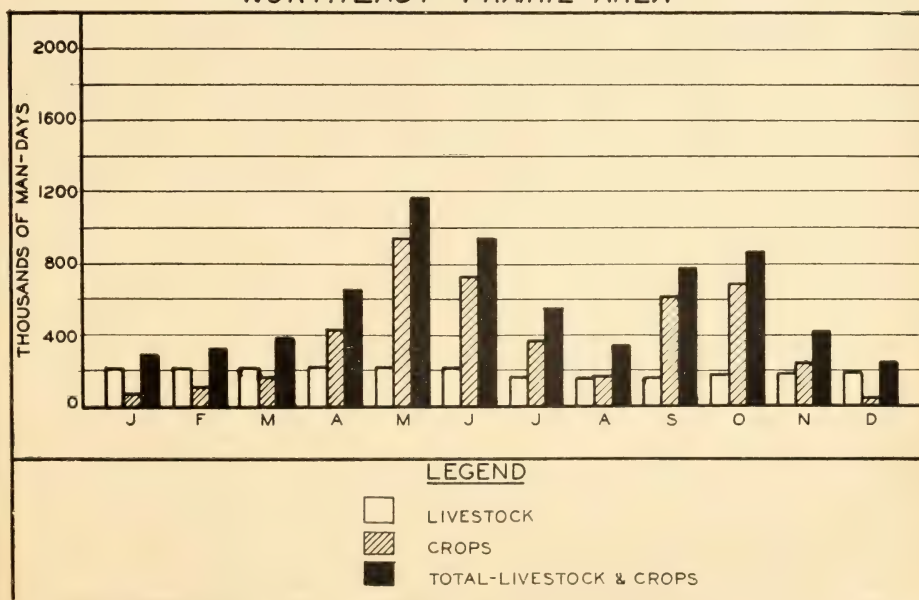


Figure 5. Total man-day labor requirements by months for regular crop and livestock enterprises, and for these two combined, based on crop acreage and livestock numbers, 1942, Northeast Prairie Area.

Table 5. Man labor and power used per acre of crops and per unit of livestock: Longleaf Pine Area, Mississippi.^{1/}

Item	Total hours			Distribution of man-hours by months												Normal yields ^{2/}
	Man	Mule	Tra.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Crops: Mule equipment																
Cotton	117.5	42.0	—	.8	1.2	5.0	11.1	16.2	14.4	7.8	12.2	33.6	15.2	—	—	280 lbs.
Corn	38.5	36.0	—	—	1.0	6.1	9.1	10.5	4.4	.4	—	—	5.8	1.2	—	15 bu.
Peanuts	66.0	36.0	—	—	—	7.5	7.5	8.0	6.4	1.6	—	25.0	—	10.0	—	700 lbs.
Soybean and cowpea hay ..	19.5	32.0	—	.6	.6	2.0	3.2	3.7	—	—	4.9	3.5	1.0	—	—	1.2 tons
Oats hay	23.0	39.0	—	—	—	—	1.5	11.0	—	—	—	—	10.5	—	—	1.0 ton
Lespedeza hay	13.5	24.0	—	—	.5	1.0	—	—	—	—	—	12.0	—	—	—	1.0 ton
Sweetpotatoes	93.0	55.0	—	—	1.5	6.5	7.5	27.0	20.5	—	—	—	30.0	—	—	110 bu.
Irish potatoes	78.0	40.0	—	.8	11.1	7.6	7.3	3.8	47.4	—	—	—	—	—	—	75 bu.
Snap beans	128.0	36.0	—	—	3.1	3.6	16.8	44.0	60.5	—	—	—	—	—	—	60 bu.
Sugarcane sirup	117.0	80.0	—	—	—	14.3	9.3	12.1	10.8	10.5	—	—	15.0	45.0	—	200 gal.
Livestock (per head) ^{3/}																
Workstock	80.0	—	—	7.0	7.0	8.0	8.0	8.0	8.0	5.0	5.0	5.0	6.0	6.0	7.0	—
Dairy cows ^{4/}	140.0	—	—	13.0	13.0	13.0	13.0	13.0	11.0	10.0	10.0	10.0	11.0	11.0	12.0	—
Beef cows ^{4/}	25.0	—	—	4.0	4.0	2.5	1.5	1.0	1.0	1.0	1.0	1.0	2.0	2.0	4.0	—
Sows, gilts and litters	72.0	—	—	7.0	7.0	8.0	6.0	5.0	4.0	4.0	4.0	6.0	7.0	7.0	7.0	—
Chickens (50 hen flock)	210.0	—	—	15.0	16.0	22.0	28.0	27.0	22.0	16.0	12.0	12.0	12.0	14.0	14.0	—

^{1/}Data from 235 practice sheets obtained in two counties, 1942.^{2/}Normal yields represent "expected yields" and are somewhat above the 5-year average for most crops, due to the large increase in use of fertilizers, use of improved varieties, and better cultural practices.^{3/}Labor requirements for livestock are on a per head basis with the exception of chickens.^{4/}Includes labor required for young animals and replacement stock.

CLAY HILLS AREA

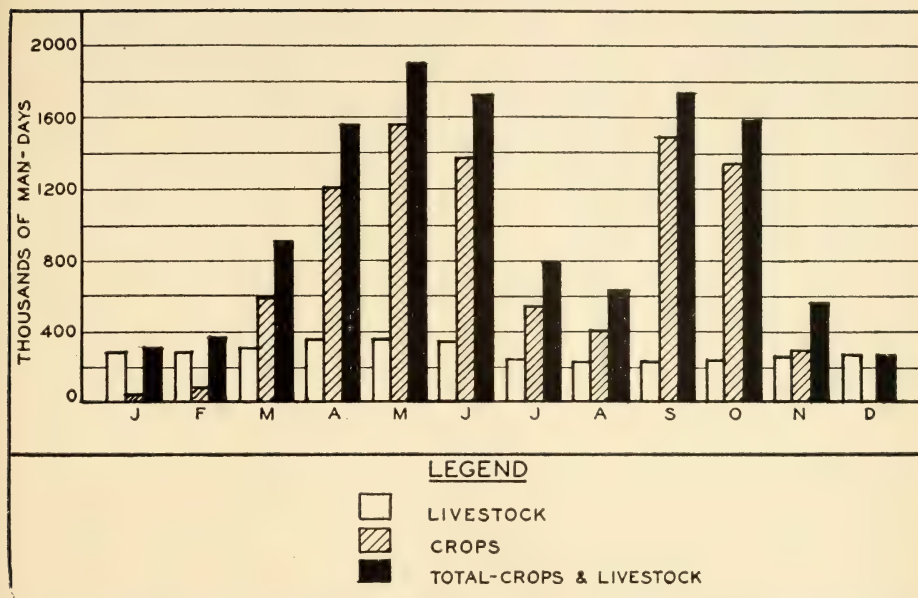


Figure 6. Total man-day labor requirements by months for regular crop and livestock enterprises, and for these two combined, based on crop acreage and livestock numbers, 1942, Clay Hills Area.

and hay without reducing the number of feed units. Such a practice results in a large saving in soil erosion and plant nutrients as well as in labor.

Temporary pastures also offer possibilities for saving labor. Small grains, crimson clover, sudan grass, soybeans, velvetbeans, and grain sorghums may be used to provide pasture throughout much of the year and replace corn and hay. Under such a system, labor is saved through a reduction in the amount of hand feeding required and by a reduction in the acreage of crops harvested for feeding livestock. In addition, the manure is left on the land, and the labor for hauling manure is eliminated. With proper management of permanent and temporary pastures, and the use of soybeans, peanuts, velvetbeans, and grain sorghums for grazing, the acreage and quantity of corn required for maintaining livestock production would be greatly reduced.

Cross cultivation may be used to reduce the labor required for hoeing cotton and corn. This practice would be practical only on fairly level sandy and silt loam soils with adequate drainage.

Staggered plantings and use of early and late maturing varieties may be used for spreading labor requirements on corn, oats, soybeans, and vegetable crops. This practice, applied to oats and soybeans, spreads combining over a longer period, increases the acreage handled per machine, and reduces the cost per bushel.

Summary

Labor Requirements for Crops and Livestock

The labor requirements presented in tables 1 to 5 represent normal labor requirements as determined by averaging reports from a number of farmers in each type-of-farming area. Corrections were made in individual schedules for varia-

tions in labor requirements due to abnormally large or small yields. Per acre labor requirements for picking cotton vary widely from farm to farm according to yield, so it was necessary to calculate labor requirements for this operation by using normal yields and the average picking rate reported for the area. Normal yields represent "expected yields" and are somewhat above the 5-year average for certain crops due to the upward trend in use of fertilizers, improvements in varieties, and improvements in cultural practices.

The composite labor requirements presented in table 6, for all crops and livestock, were obtained by multiplying weighted average labor requirements per acre and per unit of livestock by the acreage and numbers reported for each area in 1942. Thus, these data do not represent accurately the 1942 situation because of the occurrence of abnormally high

cotton yields. They do indicate roughly the seasonal pattern of total labor requirements and the total number of man days that would be needed to meet peak labor demands with the 1942 acreage and livestock numbers and a normal season.

Seasonal Distribution of Labor Requirements

In the Brown Loam and Clay Hills Areas, there is considerable variation in the seasonal distribution of labor as between the extreme northern and southern portions of these areas. In the Brown Loam Area, planting, hoeing, and cotton picking are started 2 to 3 weeks earlier in the southern tier of counties than in the extreme northern part of the area. Cotton picking is usually finished in October in the southern counties, which is nearly a month earlier than is the case in the northern part of the area. Also, lower production per family in the south-

LONG LEAF PINE AREA

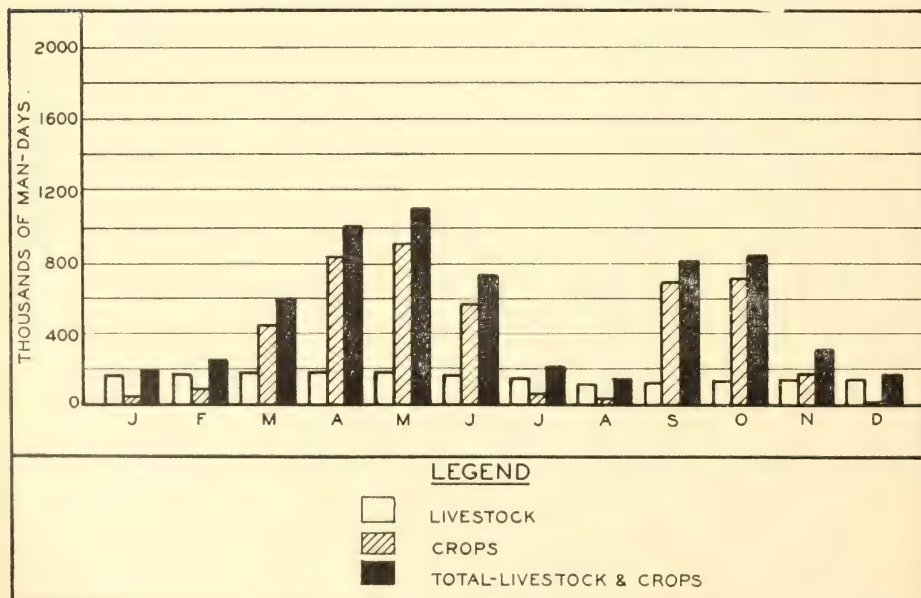


Figure 7. Total man-day labor requirements by months for regular crop and livestock enterprises, and for these two combined, based on crop acreage and livestock numbers, 1942, Long Leaf Pine Area.

Table 6. Seasonal distribution by areas of total labor requirements for crops and livestock: all crops, Mississippi.

Area	Unit	Distribution by months												
		Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1,000 man days														
Delta	do	48.5	57.5	250.4	614.6	2,450.5	1,560.4	1,244.9	1,214.5	3,520.6	2,869.2	1,639.0	572.3	16,042.4
Brown Loam	do	43.6	210.4	766.4	1,472.8	2,046.9	1,359.6	639.4	575.1	1,973.2	1,579.3	310.4	38.7	11,015.8
Clay Hills	do	26.3	84.2	596.1	1,202.1	1,537.2	1,389.5	545.1	403.9	1,498.6	1,346.9	299.0	—	8,928.9
Northeast Prairie	do	75.1	102.6	176.3	437.8	947.4	738.9	380.3	171.3	614.3	693.3	243.6	49.8	4,630.7
Longleaf Pine	do	23.5	86.9	427.1	820.1	915.6	565.4	76.0	28.0	687.3	711.3	164.8	4.1	4,510.1
Coastal Plains	do	2.9	17.0	90.3	149.7	177.8	98.4	12.7	30.4	96.3	108.9	30.4	2.9	817.7
Oktibbeha Dairy	do	2.7	8.5	15.6	42.2	51.2	53.4	29.9	11.6	40.3	42.8	11.6	1.9	311.7
Copiah Truck	do	16.2	29.4	56.2	89.3	122.6	68.7	19.7	21.1	70.9	63.2	20.7	10.7	588.7
Gulf Coastal	do	.4	2.2	9.2	12.4	16.4	10.1	1.7	1.0	5.7	10.5	3.5	.2	73.3
State Total ^{1/}	do	220.3	560.8	2,315.8	4,709.5	8,091.8	5,722.3	2,900.1	2,424.2	8,396.0	7,319.4	2,690.7	668.0	46,018.9
All livestock														
Delta	do	166.8	169.6	182.3	212.0	211.3	211.3	167.7	150.6	155.0	157.5	157.5	167.2	2,108.8
Brown Loam	do	348.9	384.9	386.6	397.5	400.4	347.0	307.6	304.0	303.8	340.1	316.2	365.3	4,202.3
Clay Hills	do	282.6	288.9	307.2	359.7	357.8	348.4	254.5	235.6	242.5	244.2	261.0	274.3	3,456.7
Northeast Prairie	do	216.9	218.4	218.5	215.1	219.3	207.8	175.5	169.4	171.5	181.8	188.9	193.5	2,376.6
Longleaf Pine	do	163.9	165.9	181.6	188.9	184.6	161.3	126.8	118.8	121.5	136.3	140.3	155.8	1,845.7
Coastal Plains	do	55.4	55.9	58.8	58.9	56.7	48.9	40.1	37.9	39.5	45.2	46.3	52.8	596.4
Oktibbeha Dairy	do	29.1	29.2	28.8	30.1	30.4	29.0	25.5	24.9	25.4	27.1	28.3	28.8	336.6
Copiah Truck	do	25.5	25.8	26.1	29.2	29.4	26.4	21.1	19.9	20.1	22.3	20.8	23.2	289.8
Gulf Coastal	do	46.4	48.6	61.1	73.2	70.4	58.1	43.7	34.9	35.2	36.9	41.3	43.6	593.4
State Total ^{1/}	do	1,280.9	1,332.2	1,396.1	1,505.3	1,500.5	1,382.8	1,115.9	1,051.2	1,069.0	1,142.0	1,151.5	1,252.5	15,179.9
Total all crops and livestock														
Delta	do	215.3	227.1	432.7	826.6	2,661.8	1,771.7	1,412.6	1,365.1	3,675.6	3,026.7	1,796.5	739.5	18,151.2
Brown Loam	do	392.5	595.3	1,153.0	1,870.3	2,447.3	1,706.6	947.0	879.1	2,277.0	1,919.4	626.6	404.0	15,218.1
Clay Hills	do	308.9	373.1	903.3	1,561.8	1,895.0	1,737.9	799.6	639.5	1,741.1	1,591.1	560.0	274.3	12,385.6
Northeast Prairie	do	292.0	321.0	394.8	652.9	1,166.7	946.7	555.8	340.7	785.8	875.1	432.5	243.3	7,007.3
Longleaf Pine	do	187.4	252.8	608.7	1,009.0	1,100.2	726.7	202.8	146.8	808.8	847.6	305.1	159.9	6,355.8
Coastal Plains	do	58.3	72.9	149.1	208.6	234.5	147.3	52.8	68.3	135.8	154.1	76.7	55.7	1,414.1
Oktibbeha Dairy	do	31.8	37.7	44.4	72.3	81.6	82.4	55.4	36.5	65.7	69.9	39.9	30.7	882.8
Copiah Truck	do	41.7	55.2	82.3	118.5	152.0	95.1	40.8	41.0	91.0	85.5	41.5	33.9	878.5
Gulf Coastal	do	46.8	50.8	70.3	85.6	86.8	68.2	45.4	35.9	40.9	47.4	44.8	43.8	666.7
State Total ^{1/}	do	1,893.0	2,105.1	3,711.9	6,214.8	9,592.3	7,105.1	4,016.0	3,475.4	9,465.0	8,461.4	3,842.2	1,920.5	61,198.8

¹ The Copiah Truck and Oktibbeha Dairy Areas are included in the totals for the Brown Loam and Northeast Prairie, respectively.

COPIAH TRUCK AREA

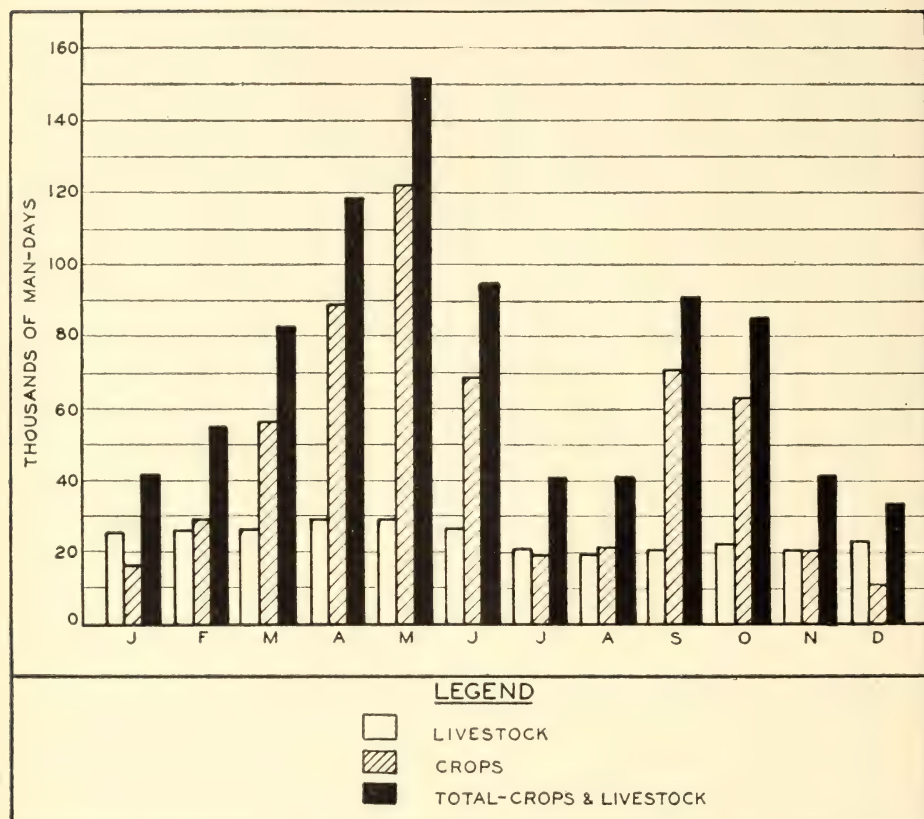


Figure 8. Total man-day labor requirements by months for regular crop and livestock enterprises, and for these two combined, based on crop acreage and livestock numbers, 1942, Copiah Truck Area.

ern part of the area contributes to the early completion of cotton picking.

In the southern counties of the Brown Loam Area it is estimated that about 20 percent of the cotton is picked in August, 60 percent in September, and 20 percent in October. Comparable figures for the northern counties are 5 percent in August, 45 percent in September, 35 percent in October, and 15 percent in November.

In the Clay Hills, the season is 10 days to 2 weeks earlier in the southern counties than in the extreme northern part of the area. Cotton planting and picking are started about 2 weeks earlier in

the southern portion of the area than in the northern counties.

In arriving at the distribution of labor requirements by months, an attempt was made to arrive at the weighted average requirements for each crop on the basis of the proportion of the crop that is located in the northern and southern weather zones of the Brown Loam and Clay Hills Areas.

The most striking features of labor requirements for crops are the extreme seasonal variation and the proportion that is attributable to cotton. Of the total crop labor requirements, about 64 percent is needed during May, June, September,

and October; the highest peak in September (table 6 and figure 2). However, on an area basis there is considerable variation in the concentration by months (figures 2 to 9). The most uniform pattern of seasonal requirements is in the Oktibbeha Dairy Area (figure 9), whereas the widest variation is in the Delta (figure 3).

Annual Labor Requirements

A total of about 61,200,000 man days are required for handling crops and livestock with the acreages and numbers as reported in 1942, assuming normal yields and weather conditions. Of this total, 76 percent is required for crops and 24 percent for all livestock enterprises including workstock. This represents about 213 man days per 1940 census farm and 197 man days per farm family.

On the basis of crops, by far the largest percentage of labor is required for cotton. Corn is the second largest crop in

terms of labor requirements. In the Delta, about 82 percent of the labor requirements is for cotton, 10 percent for corn, 4 percent for hay, and 4 percent for other crops. Although about 15 percent of the Delta crop acreage in 1942 was in oats and soybeans for oil, only about 3 percent of total labor requirements was needed for these two crops.

In the Brown Loam Area about 65 percent of the total labor requirements is for cotton, 25 percent for corn, and 10 percent for other crops. For the other hill areas, the percentage of labor required for cotton is somewhat smaller than is the case for the Brown Loam Area.

On a type-of-farming area basis, labor requirements per crop acre are much higher for the Delta than for any other area. This is due to the high percentage of the cropland in cotton and to high per acre yields as compared to the rest of the State. In 1942, more than one-

OKTIBBEHA DAIRY AREA

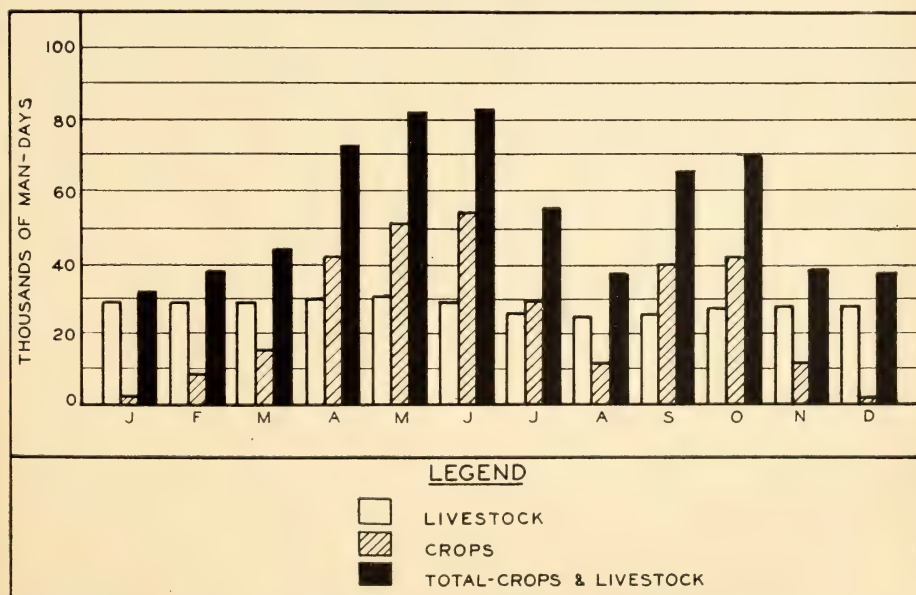


Figure 9. Total man-day labor requirements by months for regular crop and livestock enterprises, and for these two combined, based on crop acreage and livestock numbers, 1942, Oktibbeha Dairy Area.

third of the total labor needs for the State were in the Delta. Average requirements per crop acre in this area are 6.9 man days as compared to 4.9 man days for the rest of the State; whereas, comparable figures per farm family are 227 and 127 man days, respectively. If livestock enterprises are included, requirements per family for all enterprises are 257 man days in the Delta as compared to 180 man days for the rest of the State.

Labor requirements per month for crops (tables 1 to 5) may be translated into the number of workers required by dividing the total number of man days by the number of suitable working days per month. The customary procedure for determining suitable working days is to use the climatological data as reported by weather stations (for a period of 5 years or more) and take out the average number of days that are too wet to work in each month in addition to Sundays and holidays. The remaining days are presumed to be suitable for field work.

To translate livestock labor requirements into number of workers needed, the required number of man days per month should be divided by the total number of days per month. Although work on crops and livestock is often performed by the same people on individual farms, the number of man days required for handling livestock should be added to the number required for crops in arriving at monthly manpower needs for a county or an area.

Labor Requirements per 100 Acres of Cropland

By way of further illustration of labor requirements by months and totals for the year, tables 7 through 11 indicate the labor requirements by type-of-farming areas for 100 acres of cropland on the basis of cropland usage in 1943. Any farm operator whose farm organization compares favorably with the pattern for the area within which he is located can

easily compute labor requirements for his farm by using the 100-acre requirements as a common denomination and his own acreage as the multiplier. For illustration, a farmer in the Delta with 950 crop acres and another farmer in the Brown Loam with 175 acres would compute labor requirements by multiplying the monthly labor requirements as indicated in tables 7 and 8 by $9\frac{1}{2}$ and $1\frac{3}{4}$, respectively. Any other multiplier, depending on the size of any given farm, would of course be used in the same way.

It should be emphasized, however, that the figures arrived at above do not reflect the total labor requirements—only the labor requirements for crops. And to be applicable to the individual farm, the land use must be similar to that indicated by the tables. Labor requirements for the handling of livestock in addition to that for crops can be computed as indicated earlier in this report for individual farms and added to that indicated for crops on a monthly basis. No effort is made here to generalize labor requirements for livestock because there is no general uniform pattern of livestock numbers as there is with reference to cropland use.

Also, it should be remembered that there is a very considerable amount of overhead labor or labor not related specifically to enterprise operation required for the operation of any farm.

Finally, in the consideration of labor requirements for individual farm units, it is generally recognized that there is considerable variation from unit to unit. Soil type, weed infestation, stand, seasonal conditions, equipment used, amount of fertilizer applied, time of performing the various operations, distance from gin and market, each has its influence on the amount of labor necessary to handle any given crop and the total amount of labor required for the over-all farm unit operation.

The area and state figures given in this report are approximately correct and should be helpful in many ways in planning agricultural programs and in efficiently mobilizing farm labor. These data are designed to be applicable to any individual farm as nearly so as averages

are ever applicable to individual cases. It is needless to point out, however, that farm operation does not lend itself to assembly line scheduled time studies which, therefore, makes it necessary to generalize with reference to individual farm labor requirements.

Table 7. Farm labor requirements for the cultivation of 100 acres of cropland with half row, row, and multiple row equipment, Delta Area, 1943*

Crop	Man-hours by months ^{1/}													
	Half-row equipment													
	Acres	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Cotton	42.3	16.9	16.9	46.5	186.1	1002.5	782.6	710.6	465.3	1544.0	1078.7	596.4	245.3	6691.8
Corn	21.2	8.5	12.7	67.8	184.4	262.9	61.5	—	—	—	212.0	8.5	25.4	843.7
Small grain	9.3	—	—	3.7	—	—	29.8	—	—	—	6.5	6.5	—	59.5
Soybeans (beans)	7.9	3.2	—	7.9	15.8	26.9	28.4	28.4	—	—	10.3	7.9	9.5	143.8
Soybeans (hay)	4.8	1.9	—	—	—	27.4	—	—	64.3	—	—	1.9	5.8	101.3
Alfalfa (hay)	2.6	—	—	—	—	22.4	22.4	22.3	—	24.7	5.2	—	—	97.0
Lespedeza (hay)	2.6	—	3	1.3	5	—	—	2.9	9.1	4.1	—	—	—	18.2
Misc. crops ²	9.3	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	100.0	30.5	29.9	127.2	386.8	1342.1	924.7	764.2	538.7	1584.8	1219.2	621.2	286.0	7955.3
One-row equipment														
Cotton	42.3	16.9	16.9	46.5	186.1	862.9	617.6	545.7	465.3	1544.0	1078.7	593.4	245.3	6222.3
Corn	21.2	8.5	12.7	67.8	150.5	203.5	29.7	—	—	—	212.0	8.5	25.4	718.6
Small grain (oats)	9.3	—	—	3.7	—	—	29.8	—	—	—	6.5	6.5	—	59.5
Soybeans (beans)	7.9	3.2	—	7.9	15.8	26.9	28.4	28.4	—	—	10.3	7.9	9.5	143.8
Soybeans (hay)	4.8	1.9	—	—	—	27.4	—	—	64.3	—	—	1.9	5.8	101.3
Alfalfa (hay)	2.6	—	—	—	—	22.4	22.4	22.3	—	24.7	5.2	—	—	97.0
Lespedeza (hay)	2.6	—	3	1.3	5	—	—	2.9	9.1	4.1	—	—	—	18.2
Misc. crops ²	9.3	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	100.0	30.5	29.9	127.2	352.9	1143.1	727.9	599.3	538.7	1584.8	1319.2	621.2	286.0	7360.7
Multiple-row equipment														
Cotton	42.3	8.5	12.7	50.8	80.4	706.4	465.3	389.2	465.3	1543.9	1078.7	587.9	220.0	5609.1
Corn	21.2	4.2	6.4	29.7	93.3	156.9	6.4	—	—	—	212.0	4.2	12.7	525.8
Small grain (oats)	9.3	—	—	3.7	—	—	29.8	—	—	—	6.5	6.5	—	59.5
Soybeans (beans)	7.9	1.6	—	3.9	7.9	14.2	19.0	—	—	5.5	10.3	6.3	4.7	92.4
Soybeans (hay)	4.8	1.0	—	—	—	18.2	—	—	57.6	—	—	9	2.9	80.6
Alfalfa (hay)	2.6	—	—	—	—	16.6	16.6	16.6	—	17.2	2.9	—	—	69.9
Lespedeza (hay)	2.6	—	3	1.3	5	—	—	2.9	9.1	4.1	—	—	—	18.2
Misc. crops ²	9.3	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	100.0	15.3	19.4	89.4	182.1	912.3	537.1	427.7	532.0	1577.2	1316.9	605.8	240.3	6455.5

*Information secured from field schedules.

† Man-hour labor requirements may be converted to 10-hour man-day labor requirements by moving decimal point one digit to the left.

‡ It should be noted that no estimate for labor requirements for miscellaneous crops was made and that this item constitutes almost 10 percent of the total cropland.

Table 8. Farm labor requirements for the cultivation of 100 acres of cropland with all mule equipment, horse and tractor equipment combined, Brown Loam Area, 1943*

Crop	Acres	Man-hours by months ^{1/}												Total
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Cotton	32.1	—	6.4	77.0	247.2	590.6	455.8	282.5	295.3	988.7	626.0	77.0	—	3646.5
Corn	40.6	—	32.5	93.4	186.7	337.0	121.8	—	—	60.9	142.1	48.7	—	1023.1
Oats for grain	2.2	—	.9	1.1	—	—	4.8	—	—	.4	4.6	2.2	—	14.0
Soybeans for beans	2.1	—	—	—	1.3	2.5	12.6	7.8	—	—	5.0	2.5	—	31.7
Soybeans for hay	2.6	—	—	—	3.6	13.8	3.1	—	16.1	16.1	1.3	—	—	54.0
Alfalfa	.2	—	—	—	—	1.7	1.7	1.7	—	1.9	.4	—	—	7.4
Lespedeza hay	4.6	—	—	1.9	—	—	2.8	—	18.4	23.0	1.8	—	—	49.7
Pea hay	2.4	—	1.8	—	3.3	12.7	2.9	—	14.9	14.9	1.2	—	—	49.9
Sorghum for silage	.3	—	—	.5	.8	1.7	.9	.2	4.0	10.0	—	—	—	18.1
Peanuts for nuts	.5	—	—	3.7	3.8	4.0	3.2	.8	—	12.5	—	5.0	—	33.0
Lespedeza and clover for seed	.6	—	.1	.1	—	.5	.8	.2	—	.4	1.0	.8	—	3.9
Sorghum for sirup	.5	—	—	2.5	1.7	3.0	4.3	3.5	—	27.0	27.0	—	—	69.0
Sugarcane	.3	—	—	4.3	4.9	3.6	3.2	1.8	—	—	9.0	10.5	—	37.3
Sweetpotatoes	1.3	—	—	11.0	24.9	31.7	11.2	—	—	12.4	55.3	—	—	145.6
Tomatoes	.3	6.1	6.6	10.8	15.1	8.4	8.7	—	—	—	—	.2	1.7	57.6
Snap beans	.2	—	1.4	1.5	2.7	11.0	7.4	—	—	—	—	—	—	24.0
Misc. crops and rotation pasture ^{2/}	9.2	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	100.0	6.1	49.7	207.8	495.1	1022.2	645.2	298.5	348.7	1168.2	874.7	146.9	1.7	5264.8

*Information secured from field schedules.

^{1/}Man-hour labor requirements may be converted to 10-hour man-day labor requirements by moving decimal point one digit to the left.^{2/}It should be noted that no estimate for labor requirements for miscellaneous crops was made and that this item constitutes almost 10 percent of the total cropland.

Table 9. Farm labor requirement for the cultivation of 100 acres of cropland, Northeast Prairie, 1943*

Crop	Acres	Man-hours by months ^{1/}												Total
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Cotton	26.4	47.5	47.5	31.7	171.6	586.1	496.3	369.9	142.6	638.9	496.3	71.3	15.8	3115.2
Corn	37.4	—	18.7	187.0	231.9	314.2	302.9	44.9	—	—	130.9	56.1	—	1286.6
Soybeans (beans)	1.3	—	—	—	.8	1.6	7.8	4.8	—	—	3.1	—	1.6	19.7
Cowpeas (seed)	.8	.8	3.2	1.6	3.2	3.2	1.6	3.2	6.4	—	—	—	—	23.2
Oats (grain)	2.0	—	.8	1.0	—	—	4.4	—	—	.4	4.2	2.0	—	12.8
Peanuts (nut)	1.0	—	—	7.5	7.5	8.0	6.4	1.6	—	25.0	—	10.0	—	66.0
Sorghum forage	.7	—	—	1.3	1.5	1.4	—	—	2.8	4.2	1.4	—	—	12.6
Johnson grass hay	9.2	—	—	—	—	5.5	73.6	50.6	11.0	16.6	12.9	—	—	170.2
Soybean hay	3.8	—	—	—	8.3	6.8	2.3	—	26.6	19.8	—	2.3	2.3	68.4
Cowpea hay	1.4	—	—	—	3.8	3.4	1.1	—	10.2	8.8	.8	1.1	.8	30.0
Lescpedeza hay	4.4	—	4.4	4.4	—	—	2.6	—	21.1	15.0	—	—	—	47.5
Alfalfa hay	.5	—	—	—	—	3.0	4.8	4.3	1.8	4.7	—	—	—	18.6
Sorghum sirup	.5	—	—	2.5	1.7	3.0	4.3	3.5	—	27.0	27.0	—	—	69.0
Sweetpotatoes	1.2	—	—	10.2	22.2	29.3	10.3	—	—	11.4	51.0	—	—	134.4
Misc. crops ^{2/}	9.4	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	100.0	48.3	74.6	247.2	452.5	965.5	918.4	482.5	222.5	771.8	727.6	142.8	20.5	5074.2

*Information secured from field schedules.

^{1/}Man-hour labor requirements may be converted to 10-hour man-day labor requirements by moving decimal point one digit to the left.^{2/}It should be noted that no estimate for labor requirements for miscellaneous crops was made and that this item constitutes almost 10 percent of the total cropland.

Table 10. Farm labor requirements for the cultivation of 100 acres of cropland, Shortleaf Pine Area, 1943*

Crop	Acres	Man-hours by months ^{1/}												Total
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Cotton	26.4	15.6	15.6	72.8	306.8	455.0	395.2	228.8	171.6	691.6	538.2	72.8	—	2964.0
Corn	46.3	—	23.1	231.5	287.1	388.9	375.0	55.6	—	—	162.0	69.5	—	1592.7
Soybeans (beans)	1.3	—	—	—	.8	1.5	7.8	4.8	—	—	3.1	1.6	—	19.6
Cowpeas (seed)	1.9	1.9	7.6	3.8	7.6	7.6	3.8	7.6	15.2	—	—	—	—	55.1
Oats (grain)	1.6	—	.6	.8	—	—	3.5	—	—	.3	—	—	—	10.2
Peanuts (nuts)	1.9	—	—	14.3	14.2	15.2	12.2	3.0	—	47.5	—	1.6	—	125.4
Soybean hay	2.3	—	3.6	5.5	5.3	9.2	8.1	—	11.5	11.5	—	19.0	—	54.7
Cowpea hay	1.9	—	3.0	4.6	4.4	7.6	6.6	—	9.5	9.5	—	—	—	45.2
Lespedeza hay	6.1	—	12.2	25.6	—	—	—	—	13.4	37.8	—	—	—	89.0
Sorghum sirup	.5	—	—	2.5	1.7	3.0	4.3	3.5	—	27.0	27.0	—	—	69.0
Irish potatoes	.5	.4	5.5	3.8	3.7	1.9	23.7	—	—	—	—	—	—	39.0
Sweetpotatoes	1.1	—	1.6	7.2	8.2	29.7	22.6	—	—	—	33.0	—	—	102.3
Misc. crops ^{2/}	8.6	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	100.0	17.9	72.8	372.4	639.8	919.6	862.8	303.3	221.2	825.2	766.7	164.5	—	5166.2

*Information secured from field schedules.

^{1/}Man-hour labor requirements may be converted to 10-hour man-day labor requirements by moving decimal point one digit to the left.^{2/}It should be noted that no estimate for labor requirements for miscellaneous crops was made and that this item constitutes almost 10 percent of the total cropland.

Table 11. Farm labor requirements for the cultivation of 100 acres of cropland, Longleaf Pine Area, 1943*

Crop	Acres	Man-hours by months ^{1/}												Total
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Cotton	25.5	20.4	30.6	127.5	283.1	413.1	367.2	198.9	311.1	856.8	387.6	—	—	2996.3
Corn	49.0	—	49.0	298.9	445.9	514.5	215.6	19.6	—	—	284.2	58.8	—	1886.5
Soybeans (beans)	1.6	—	—	—	1.0	1.9	9.6	5.9	—	—	3.8	1.9	—	24.1
Cowpea (seed)	1.1	1.1	4.4	2.2	4.4	4.4	2.2	4.4	8.8	—	—	—	—	31.9
Oats (grain)	2.5	—	1.0	1.2	—	—	5.5	—	—	5	5.3	2.5	—	16.0
Peanuts (nuts)	1.2	—	—	9.0	9.0	9.6	7.7	1.9	—	30.0	—	12.0	—	79.2
Soybean hay	1.9	1.1	1.1	3.8	6.1	7.0	—	—	9.3	6.7	1.9	—	—	37.0
Cowpea hay	1.7	1.0	1.0	3.4	5.4	6.3	—	—	8.3	6.0	1.7	—	—	33.1
Lespedeza hay	2.2	—	1.1	2.2	—	—	—	—	—	26.4	—	—	—	29.7
Sugarcane sirup	1.0	—	—	14.5	9.3	12.1	10.8	10.5	—	—	15.9	45.0	—	117.0
Irish potatoes	1.3	1.0	14.4	9.9	9.5	4.9	61.6	—	—	—	—	—	—	101.3
Sweetpotatoes	3.2	—	4.8	20.8	24.0	86.4	65.6	—	—	—	96.0	—	—	297.6
Misc. crops ^{2/}	7.8	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	100.0	24.6	107.4	493.2	797.7	1060.2	745.8	241.2	337.5	926.4	795.5	120.2	—	5649.7

*Information secured from field schedules.

^{1/}Man-hour labor requirements may be converted to 10-hour man-day labor requirements by moving decimal point one digit to the left.^{2/}It should be noted that no estimate for labor requirements for miscellaneous crops was made and that this item constitutes almost 10 percent of the total cropland.

STATE COLLEGE, MISSISSIPPI

Construction and Operation of the Summer Egg Cooler

By C. A. ROBERTS and H. D. POLK

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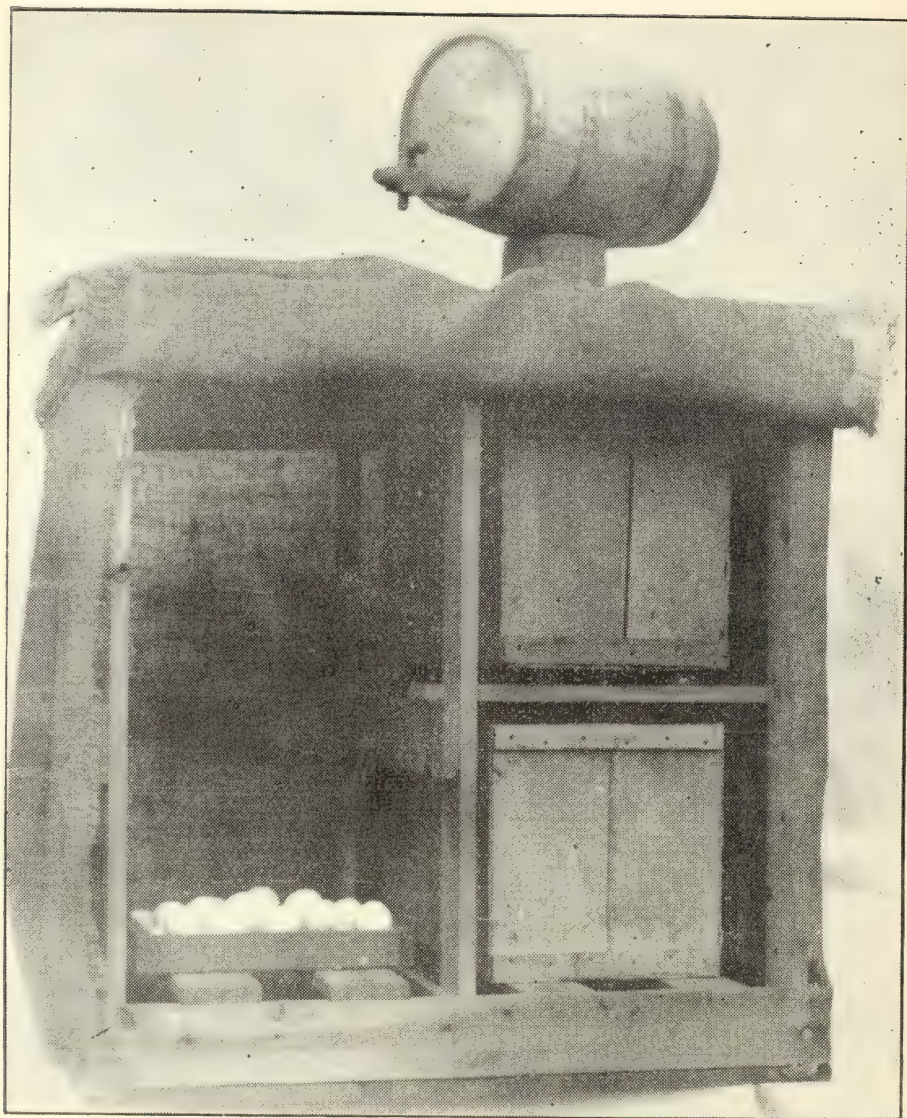


Figure 1. The Oklahoma egg cooler. Note eggs in separate cooling compartment until cased in early morning, 2-case storage capacity, and water keg for moistening where running water is not available.

Construction and Operation of the Summer Egg Cooler

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Recent expansion of commercial egg production in Mississippi, made largely in answer to increased demands for food needed by our soldiers and our allies, has emphasized the importance of efficient methods of temporary storage on the farm from the time the egg is laid until it is marketed.

Large government purchases of eggs for use in military training centers and for export are made on the basis of grade. Quality eggs bring attractive prices, while eggs of inferior quality are not wanted, even at much lower prices. A considerable commercial egg-producing industry is being built up to supply these war demands; and after peace comes, it is anticipated that commercial egg production will continue, marketings to be through regular commercial channels.

Therefore, for sale through government purchases as at present, or for sale through regular commercial channels later, the quality of eggs marketed by Mississippi farmers will not only determine the price received per dozen or per case, but will largely determine also whether attractive markets may continue to be gained and held.

For highest quality, eggs should be gathered three times each day, and marketed daily. Many farmers not in position to market eggs daily, have mechanical or ice refrigerators in which to keep the eggs. Large numbers of farmers, however, are not so fortunately situated. As a result, much of the commercial egg production is marketed once to twice a week, and serious losses are incurred through lowered egg quality because of inadequate farm storage facilities.

To meet the needs of poultrymen unable to market eggs as often as three times a week, or lacking refrigerator storage facilities, the Oklahoma Agricultural Experiment Station some years ago

constructed and introduced an inexpensive homemade egg cooler which operated quite satisfactorily under Oklahoma conditions. Used by the Mississippi Station during 1941, however, it was only partially successful. Results of this work are shown in tables 1 and 4.

It was believed that the lack of complete success of the Oklahoma egg cooler in 1941 was due chiefly to differences in climate, principally in the steady wind usually present in Oklahoma but often lacking in Mississippi. Hence, during 1942, a cooler was constructed in which the Oklahoma cooler was altered only in detail, to provide for the greater evaporation of water. Results from the use of the remodeled egg cooler are shown in tables 2 and 5.

Previous tests of the egg cooler have been made with the cooler under the shade of a tree. To determine whether such shade was necessary or helpful, during the latter half of 1942, the work was done with the cooler in the open sunshine. Results are shown in tables 3 and 6.

Four Types of Storage Tested

The Oklahoma egg cooler as slightly revised by the Mississippi Station is a homemade double stand, which is covered with burlap, and the cloth is kept moist by the constant dripping of water. Thus, it makes use of the cooling effect of evaporation. At the same time the evaporation principle provides humidity and thus prevents evaporation of the moisture content of the egg. Materials may be found on most farms, and but little mechanical skill is required for its construction.

In the three experiments reported, one egg cooler was kept moist; the other was kept dry to serve as a check against the moist cooler.

A third method of storing was in an

ordinary cellar, which was dry and relatively cool.

The fourth method tested was room storage; in this case, the incubator room of the poultry department of the Mississippi Experiment Station.

Under all of the four methods, the eggs were kept in open containers for one day for maximum cooling, then were placed in standard 30-dozen egg cases.

The egg cooler was not used either in the cellar or in the room storage.

Since the tests were made during summer, eggs were gathered three times daily—at 10 a. m., 2 p. m., and 4 p. m.—during the warmest weather, and were immediately placed in storage. The production of eggs varied, of course, from day to day, but was evenly divided among the four storage lots. Readings of humidity and temperature were taken three times daily, at 6 a. m., 12 m., and 6 p. m., central standard time. Eggs in all lots were graded at 4 p. m. every Friday afternoon during the test. Since each day's addition of eggs was separately marked, this weekly reading gave the grades of eggs which had been in storage 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, and 7 days.

Grades of Eggs

Since government purchases of eggs utilize an increasingly large portion of the commercial egg crop in Mississippi, the prevailing egg grades are used in this

report. The AA grade corresponds to U. S. Specials, Grade A to U. S. Extras, Grade B to U. S. Standard, and Grade C to U. S. Trade. There are but few Grade AA eggs. Prices vary from time to time and from place to place. Generally, about 2 cents per dozen more is paid for Grade A than for B, and for Grade B than for Grade C eggs.

Experiments in 1941

The egg coolers, both moist and dry, used in 1941 were constructed after specifications by the Oklahoma Experiment Station. By reference to table 1, it will be noted that the temperature in the moist cooler averaged approximately 5 degrees lower than in the dry cooler, and approximately 8 degrees lower than in room storage. The dry cooler was slightly cooler than room storage but not so cool as the cellar.

By reference to table 4, showing the effect of these four storage conditions on egg grades, it will be noted that after the fourth day of storage in the moist cooler, mold was increasingly present to the extent that on the seventh day, approximately one-third of the eggs had surface mold and thus were thrown into the lowest price classification, while four eggs were inedible because of the interior mold. In the 1941 test, the dry cooler was not as good as the moist cooler on the first 5 days of storage, after which surface mold developed in the moist cool-

Table 1. Average results showing temperature and relative humidity of storing eggs under 4 storage conditions. Egg coolers in shade. May 20-September 18, 1941

	Eggs stored in cooler; cooler kept moist	Eggs stored in cooler; cooler kept dry	Eggs stored in cellar	Eggs stored in room
Temperature*				
6 a. m.	73	75	77	79
12 m.	79	87	81	88
6 p. m.	78	85	81	88
Relative humidity*				
6 a. m.	95	87	85	83
12 m.	90	69	79	65
6 p. m.	92	74	79	66

*Readings at hours shown, central standard time.

er. Room storage was the least desirable of all at every day of storage of the four methods tested, although it was approximately as good as the dry cooler on the seventh day of storage.

Experiments in 1942—Egg Coolers in Shade

Since the mold which largely destroyed the effectiveness of the moist cooler during 1941, was due to excessive accumulated moisture, simple changes were made in construction so that excessive moisture might not accumulate or come in contact with the eggs or egg cases. These changes appear to have accomplished the desired effect, and reference to table 5 reveals that no egg mold was indicated in the moist cooler eggs.

The effectiveness of the moist egg cooler is clearly shown in this study. For storage periods of more than 5 days, it will be noted that in the dry cooler, the number of Specials and Extras (Grade A eggs) decreased with every day of storage—from 111 eggs on the first day to only 25 on the seventh day.

Under room storage, the number of top grade eggs similarly decreased from 96 on the first day to 25 on the seventh. In the moist cooler, approximately three times as many Grade A eggs remained on the seventh day.

The effectiveness of a cool, dry cellar for the storage of eggs is likewise shown in this study. The cellar was, in fact, slight-

ly superior to the moist cooler during the first 4 days of storage, about equal to the moist cooler on the fifth day of storage, but slightly inferior to the moist cooler on the sixth and seventh days of storage.

Storage Experiments in 1942—Coolers In Open Sunshine

To determine whether shade was necessary for the most satisfactory operation of the egg cooler, the wet and dry coolers were moved during the last 6 weeks of the 1942 experiment into the open sunshine.

It will be observed in table 2 that the average temperatures were slightly higher under all storage methods than during the preceding period when both coolers were kept in the shade. A very considerable difference was noted in egg grades, as shown in table 6. Relatively fewer eggs were in Grade A after 1 day of storage, although the deterioration in quality was in about the same proportion. Relatively more eggs were in Grade B after 1 day of storage. Also, the increase in numbers of Grade B eggs differed greatly from the relative increase shown while the cooler was in the shade. However, it should be stated that eggs stored in the room and in the cellar were likewise of somewhat lower grade during the second period of the test than in the first period.

Under the apparently unfavorable circumstances of direct sunshine and the ab-

Table 2. Average results showing temperature and relative humidity, of storing eggs under 4 storage conditions. Egg coolers in shade. June 1-July 26, 1942.

	Eggs stored in cooler; cooler kept moist	Eggs stored in cooler; cooler kept dry	Eggs stored in cellar	Eggs stored in room
Temperature*				
6 a. m.	72	75	76	77
12 m.	79	88	80	88
6 p. m.	78	85	80	85
Relative humidity*				
6 a. m.	94	83	83	79
12 m.	83	61	76	63
6 p. m.	87	65	75	63

*Readings at hours shown, central standard time.

Table 3. Average results showing temperature and relative humidity, of storing eggs under 4 storage conditions. Egg coolers in sunshine. July 27-August 30, 1942.

	Eggs stored in cooler; cooler kept moist	Eggs stored in cooler; cooler kept dry	Eggs stored in cellar	Eggs stored in room
Temperature*				
6 a. m.	71	73	77	75
12 m.	82	89	79	86
6 p. m.	79	84	80	86
Relative humidity*				
6 a. m.	93	88	82	84
12 m.	81	63	76	66
6 p. m.	85	67	76	66

*Readings at hours shown, central standard time.

Table 4. Effect on egg grade after storage from 1 to 7 days under four storage methods. Egg coolers in shade. May 20-September 18, 1941.

Treatment and Grade	1st day (No. eggs)	2nd day (No. eggs)	3rd day (No. eggs)	4th day (No. eggs)	5th day (No. eggs)	6th day (No. eggs)	7th day (No. eggs)
Moist Cooler							
Grade AA (U.S. Special)...	20	16	12	16	4	4	2
Grade A (U.S. Extra).....	255	260	217	243	209	153	117
Grade B (U.S. Standard)...	43	39	68	95	88	83	81
Grade C (U.S. Trade).....	0	3	3	0	32 ³	85 ²	119 ¹
Inedible*	0	0	0	0	0	0	4
Dry Cooler							
Grade AA (U.S. Special) ...	19	8	0	0	0	0	0
Grade A (U.S. Extra)	251	217	191	198	148	115	88
Grade B (U.S. Standard) ...	46	85	97	148	179	178	196
Grade C (U.S. Trade).....	1	8	12	7	13	30	50
Inedible*	0	0	0	0	0	0	0
Cellar							
Grade AA (U.S. Special) ...	26	17	7	1	0	0	0
Grade A (U.S. Extra).....	249	230	190	201	156	142	134
Grade B (U.S. Standard) ...	41	69	97	140	162	155	169
Grade C (U.S. Trade).....	2	3	6	17	17	26	31
Inedible*	0	0	0	0	0	0	0
Room							
Grade AA (U.S. Special) ...	0	0	0	0	0	0	0
Grade A (U.S. Extra).....	283	188	136	131	96	71	60
Grade B (U.S. Standard) ...	79	108	119	146	159	168	171
Grade C (U.S. Trade).....	4	23	45	76	80	90	101
Inedible*	0	0	0	0	0	0	0

¹110 eggs had surface mold; ²79 eggs had surface mold; ³30 eggs had surface mold.

*The term "inedible" refers to eggs made so by germ development during storage; eggs which were inedible when placed in storage, largely due to blood spots, were discarded and were not included in the above figures.

sence of shade, the moist cooler proved more efficient in the preservation of quality than any other method tested. As in the previous tests, the cellar proved to be almost as satisfactory as the moist cooler. The dry cooler was approximately equal to room storage, but both were unsatisfactory.

Observations on Results

The foregoing results of two seasons' work on the temporary storage of eggs seem clearly to indicate that farmers who have cool dry cellars in which to store the eggs, especially where eggs are marketed at least twice per week, have perhaps the most satisfactory and trouble-free

method of egg storage short of refrigeration.

Where neither cellar nor refrigerator is available, the moist egg cooler seems to have proved its worth. It appears that the moist egg cooler is best kept under shade. The same egg cooler without moisture is little, if any, better than room storage.

Interpretation of Table 5

It is believed that the work done while the egg coolers were in the shade during the first half of the 1942 test is most representative of the effect of the moist cooler on the grade of stored eggs. This is because difficulty experienced in 1941 had been overcome, and because the moist cooler appeared to operate more satisfactorily in the shade than in open sunshine. Therefore, attention is particularly directed toward results shown in table 5.

As set forth previously, Grade AA eggs are most valuable, Grade A eggs are more valuable than Grade B, Grade B eggs are more valuable than Grade C eggs, and inedible eggs are valueless. Therefore, in comparing methods of storing, it is well to note the number of eggs in each of these five grades on any day or all days of storage. Thus, in lot 1, in the moist cooler, of 179 eggs graded after one day's storage, 27 Grade AA, 95 were Grade A, and 56 Grade B; whereas, in the cellar, of 174 eggs stored, 17 were Grade AA, 115 were Grade A, and 41 Grade B. This would indicate that the cellar was slightly more satisfactory for one day's storage. After 7 days storage, of 181 eggs stored in the moist cooler, 4 were in Grade AA, 72 were Grade A, 92 were Grade B; whereas, in the cellar, of 181 eggs stored 7 days, there were no Grade AA eggs, 57 were Grade A and 96 were Grade B. There were 13 Grade C eggs in the moist cooler and 28 in the cellar, thus indicating that while the cellar might have been preferable during short storage periods, the moist cooler

was preferred where eggs are marketed only once a week. Similar comparisons will show the superiority of these two storage mediums over the two other mediums tested.

All along it has been known that eggs should be marketed frequently. Daily marketing, wherever possible, has been commonly recommended; marketing at least three times a week has been suggested as the minimum necessary for the sale of quality eggs.

A detailed study of table 5 will show just what happens when eggs are kept under the four tested methods of storage. Comparison of the top market grades, as suggested in the paragraph above reveals that the frequent marketing of eggs is still highly important even when using the best storage method studied in this test. Regardless of the method of storage, there is deterioration from day to day after the egg is laid. Under the best methods (moist cooler, and cellar) the deterioration is slight for the first 2 days but increased thereafter. In the case of the least desirable method of storage (room) there is depreciation in quality after even one day of storage, which increases from day to day, until on the seventh day there is a serious economic loss due to the lowering of all grades and to the increase of inedible or worthless eggs.

Not all egg producers, however, market eggs three times or more per week without serious cost for transportation to market or loss of valuable time. It is suggested that a detailed study of table 5 will enable many producers to compare the cost of moving eggs to market more frequently, with the cost in decreased egg value because of holding longer periods, thus to arrive at a point at which it may be most profitable to market eggs.

In any event, wherever refrigeration or a cool dry cellar is not available, it is recommended that the moist cooler be con-

Table 5. Effect on egg grade after storage from 1 to 7 days under four storage methods. Egg coolers in shade. June 1 - July 26, 1942.

Treatment and Grade	1st day (No. eggs)	2nd day (No. eggs)	3rd day (No. eggs)	4th day (No. eggs)	5th day (No. eggs)	6th day (No. eggs)	7th day (No. eggs)
Moist Cooler							
Grade AA (U.S. Special)....	27	20	10	6	4	2	4
Grade A (U.S. Extra).....	95	104	93	79	95	88	72
Grade B (U.S. Standard)....	56	64	68	85	80	72	92
Grade C (U.S. Trade).....	1	1	1	2	5	8	13
Inedible*	0	0	0	0	0	0	0
Dry Cooler							
Grade AA (U.S. Special)....	7	10	2	0	2	1	0
Grade A (U.S. Extra).....	104	85	67	51	52	34	25
Grade B (U.S. Standard)....	66	81	79	87	87	83	84
Grade C (U.S. Trade).....	2	15	21	38	42	51	66
Inedible*	0	0	0	0	1	1	4
Cellar							
Grade AA (U.S. Special)....	17	22	10	3	0	0	0
Grade A (U.S. Extra).....	115	115	98	89	74	56	57
Grade B (U.S. Standard)....	41	52	63	77	102	97	96
Grade C (U.S. Trade).....	1	2	1	4	8	20	28
Inedible*	0	0	0	0	0	0	0
Room							
Grade AA (U.S. Special)....	6	5	0	0	0	0	0
Grade A (U.S. Extra).....	90	87	69	42	31	25	25
Grade B (U.S. Standard)....	65	72	72	88	91	87	64
Grade C (U.S. Trade).....	12	24	33	42	56	56	79
Inedible*	0	2	0	1	5	5	13

*The term "inedible" refers to eggs made so by germ development during storage; eggs which were inedible when placed in storage, largely due to blood spots, were discarded and were not included in the above figures.

structed and put in operation, especially during the summer months.

Constructing the Cooler

To construct a summer egg cooler the following steps are suggested:

1. Prepare the bill of materials as listed under "bill of materials."

2. Examine figure 1 (shown on page 1).

(a) Nail together the framework of the sides and the center partition. The 6 upright pieces are 36 inches long. The space between the top of the bottom cross-piece and the top of the center crosspiece is $13\frac{1}{2}$ inches.

(b) Use the remaining five 36-inch 1x4 pieces to complete the framework. Use one piece each at the top and bottom in front, and one each at the top, bottom and center in the back. The top edge of the center piece in the back should be $\frac{3}{4}$ of an inch above the top edge of the crosspieces.

(c) Turn the framework bottom up and place a piece of the roofing in place, using 3 of the 1x12x33 $\frac{3}{4}$ -inch pieces and one of the 1x2x33 $\frac{3}{4}$ -inch pieces. Nail a floor over the roofing material, and to the framework. The roofing material will make the bottom air-tight, and thereby prevent warm air from entering the cooler from the bottom and raising the temperature in the cooler.

(d) Turn the framework back over and nail the top on, using the remaining 1x12x33 $\frac{3}{4}$ -inch and 1x2x33 $\frac{3}{4}$ -inch pieces. Bevel the edges all the way around and nail the roofing material in place over the top as illustrated in figure 1. Place nails only along the beveled edges. If they are placed elsewhere the cooler will leak.

(e) Fit the remaining 1x4 pieces in place to form false bottoms. See figure 1, right and left side. Use the three re-

maining 1x2 pieces to form a support on the right side for the upper egg case.

3. Examine figure 2.

(a) Rip one of the burlap bags at the seam and place over the top of the cooler. Trim the edges so they do not hang below the bottom edge of the 1x4 around the top of the framework. Stretch the burlap smooth but not tight.

(b) Rip open the remaining sacks. Sew together the amount needed to enclose three sides of the cooler. Leave the front open. The lower edge of the burlap must hang even with the bottom of the cooler. Roll the upper edge of the burlap around the lath to take up the surplus.

The lath should be rolled outward so the burlap hangs next to the framework from top to bottom. The upper edge of the lath should be about 1½ inches from the top of the cooler. Five egg-case nails are sufficient for attaching each

lath. Attach the bottom of the burlap to the framework at each end only.

(c) Cut a piece of burlap for the front so that it will extend 4 inches on either side. Attach the front in the same manner as the rest of the sack material. Tack each end of the top part of the front to the sides. Arrange a nail or hook on each side at the bottom to which the front may be attached to prevent it from blowing open.

Bill of Materials

List of material necessary to construct a 2-case summer egg cooler.

- 11 pieces 1x4x36
- 11 pieces 1x4x32
- 2 pieces 1x4x33¾
- 1 piece 1x4x19½
- 2 pieces 1x2x29
- 2 pieces 1x2x33¾
- 6 pieces 1x12x33¾

Table 6. Effect on egg grade after storage from 1 to 7 days under four storage methods. Egg coolers in sunshine. July 27 - August 30, 1942.

Treatment and Grade	1st day (No. eggs)	2nd day (No. eggs)	3rd day (No. eggs)	4th day (No. eggs)	5th day (No. eggs)	6th day (No. eggs)	7th day (No. eggs)
Moist Cooler							
Grade AA (U.S. Special)...	1	6	0	0	0	0	0
Grade A (U.S. Extra).....	40	22	21	23	25	22	31
Grade B (U.S. Standard)....	75	91	93	100	88	84	79
Grade C (U.S. Trade).....	3	4	5	4	12	12	13
Inedible*	0	0	0	0	1	6	0
Dry Cooler							
Grade AA (U.S. Special)...	0	0	0	0	0	0	0
Grade A (U.S. Extra).....	31	21	19	12	26	8	4
Grade B (U.S. Standard)....	85	92	81	97	81	98	82
Grade C (U.S. Trade).....	3	6	20	17	18	13	36
Inedible*	0	0	0	0	0	0	0
Cellar							
Grade AA (U.S. Special)...	0	0	0	0	0	0	0
Grade A (U.S. Extra).....	37	24	30	41	21	14	13
Grade B (U.S. Standard)....	74	84	84	78	94	93	98
Grade C (U.S. Trade).....	2	9	9	10	9	12	14
Inedible*	0	0	0	0	0	0	0
Room							
Grade AA (U.S. Special)...	0	0	0	0	0	0	0
Grade A (U.S. Extra).....	24	23	34	10	14	7	3
Grade B (U.S. Standard)....	88	85	74	86	95	97	85
Grade C (U.S. Trade).....	5	10	7	28	18	16	37
Inedible*	0	0	0	0	0	0	0

*The term "inedible" refers to eggs made so by germ development during storage; eggs which were inedible when placed in storage, largely due to blood spots, were discarded and were not included in the above figures.

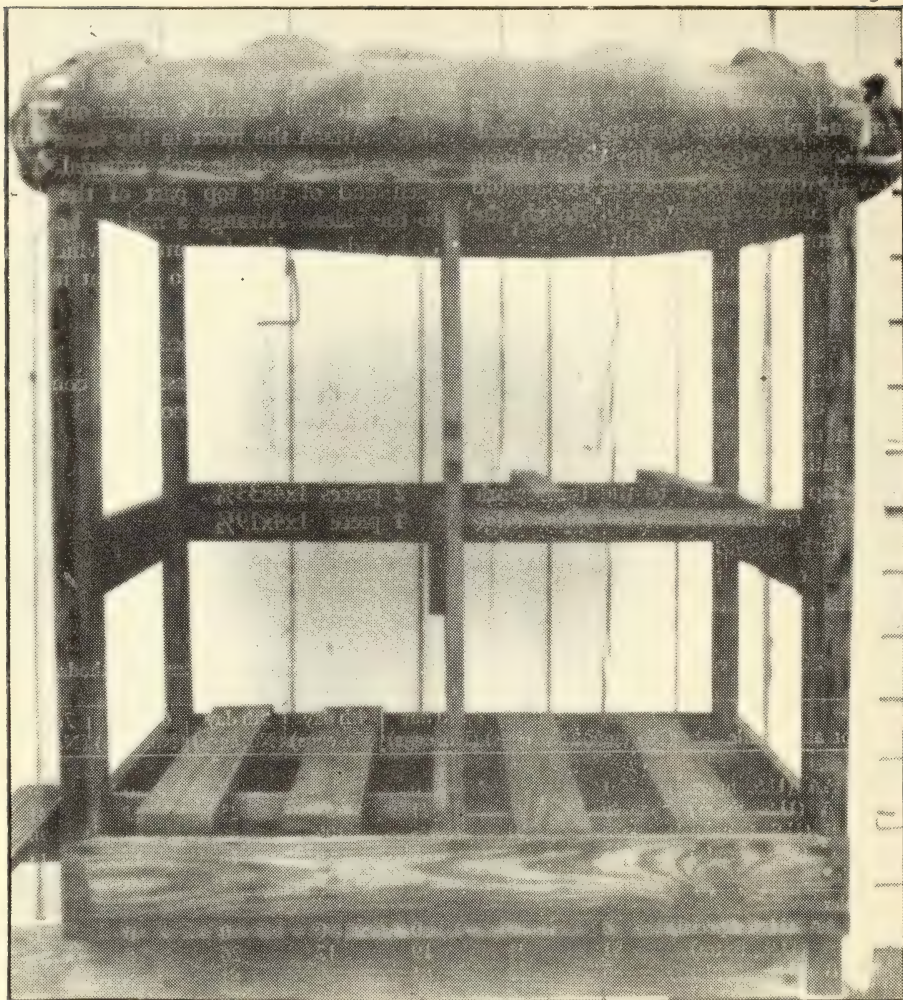


Figure 2. The egg-cooler as adapted to Mississippi conditions. Note that strips at bottom to support cases are suspended within the bottom frame, and do not touch either the bottom frame or the moistened burlap. The burlap is tacked to the lower edge of the top frame, all the way around.

- 2 pieces lath $36\frac{1}{2}$ inches long
- 2 pieces lath $33\frac{3}{4}$ inches long
- 2 pieces $33\frac{3}{4} \times 36$ composition roofing for top and bottom
- 5 burlap bags measuring at least 40 inches from top to bottom
- 1 pound No. 5 or 6 nails
- 1 pound $\frac{1}{2}$ -inch roofing nails.

Operating the Cooler

The cooler should be placed on a stand 24 to 36 inches above the ground. Preferably it should be located in the shade, but it should not be so located that it will be sheltered from the wind. The efficiency of the cooler depends on the air passing through the wet burlap and being

cooled by evaporation of the moisture.

The cooler does not need protection from the weather. However, it should be firmly attached to the stand and the stand anchored to the ground to prevent strong winds from overturning it.

The top of the cooler must be level so that water from the top will feed down around all sides equally. A dry spot anywhere on the burlap will raise the temperature within the cooler. If piped water is not available, a small reservoir placed at a higher level than the top of the cooler will answer the purpose as a source of water. Note figure 1. Whatever method is used for supplying water, the water must fall in the center of the top of the cooler. Otherwise an equal distribution of water over the sides of the cooler will not be obtained and dry spots will occur on the burlap.

It is important that just enough water to keep the burlap wet be permitted to escape the source of water supply. The burlap should not be so wet that water constantly runs from its bottom edges. If the burlap is so wet that the air cannot pass through its meshes the interior of the cooler is likely to become stagnant and warm.

Operate the cooler empty a few days to be sure it is functioning satisfactorily.

Keep egg cases and fillers and flats in the cooler at least overnight before placing eggs in them. See figure 2. In this

way the cases and equipment will be cooled down and will not cause the temperature within the cooler to rise.

Eggs should be cooled in the separate compartment overnight before they are cased. See left side of figure 1.

The coolest time during any 24-hour period is usually between five and six a. m. If the eggs are placed in the cases at that time after cooling overnight, the cooled cases, fillers and flats will afford insulation that will prevent the eggs from warming up much during the day.

The cooler should never be opened except when necessary for routine operations.

Occasionally a mold accumulates on the casing equipment, and may attack the eggs and lower their quality. This mold can be avoided to a certain extent by changing cases each time eggs are marketed, so that eggs enter the cooler in dry cases.

Any one gathering of eggs should not be left in the cooler longer than 6 or 7 days. The summer egg cooler is desirable only as a means of preserving egg quality from one market day to the next.

Eggs should be marketed at least once a week, and more often if possible.

It should be remembered that egg quality is at its best when the egg is laid, and that it loses quality thereafter regardless of the method of preservation.



The Effect of Boll Weevil Infestation At Different Levels On Cotton Yield

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SUMMARY

The cotton plant reacts to the loss of squares of the size punctured by the boll weevil by setting a higher percent of the young bolls and by producing heavier bolls.

The percent of young bolls produced that matured was higher on plants that had as few as 10 percent of the squares removed throughout the season than on untreated checks. This percent increased from week to week as the percent of squares removed was increased.

Fewer bolls were required to make a pound of seed cotton on the treated plats than on the check, when the bolls were protected from weevil damage. The decrease was nine or more bolls per pound on those plats that had all of the squares removed after the seventh week of square production.

The highest average yield the first year was made by plats that had 10 percent of the squares removed the first week of square production, increased by 10 percent each week through the fifth

week to 50 percent and held at that level for the remainder of the season. The greatest loss from this treatment in any one of the 3 years was 5.5 percent. Plats that had the percent of squares removed increased to 40 the fourth week and held at that level for the remainder of the season exceeded the yield of the check 2 years and yielded within 1 percent of it the third.

The average percent of locks lost in bolls was 1.05 in 1939 and 1.1 in 1942 for each percent of weevil infestation on the day the bolls were marked as blooms. A very high weevil infestation that developed within a short time late in the season of 1940 caused severe damage to bolls set on cotton that had been delayed in fruiting by a flood.

Exclusive of a few bolls set very early and late in the season four varieties of cotton set approximately 80 percent of their crop during the first 5 weeks of fruiting and over 70 percent during the second, third, fourth, and fifth weeks.

THE EFFECT OF BOLL WEEVIL INFESTATIONS AT DIFFERENT LEVELS ON COTTON YIELD

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During the fruiting cycle of the cotton plant, squares are more numerous in the first part and bolls in the latter part. The squares are subject to damage by the boll weevil (*Anthonomus grandis* Boh.) for a period of about sixteen days before they bloom. The bolls are relatively resistant to weevil damage after the first 3 weeks of development.

A normal cotton plant is able to replace squares and blooms lost from external damage. Too, it has been shown to react to a partial loss of blooms by setting a higher percent of those remaining on the plants.

The importance of these factors in the most economical use of control measures makes it desirable to have a better understanding of the relation of the fruiting habits of the plant to the loss of squares, the size damaged by the weevil, and the amount of damage to bolls that can be expected from different degrees of weevil infestations.

The data presented have been taken under field conditions in the vicinity of State College and Starkville, Mississippi.

Procedure

It is practically impossible to obtain data on the effect of loss of squares on yield under field conditions from actual infestations. It was necessary to simulate the damage by the removal of the squares from small plats on which the weevil infestation was kept as well under control as possible. The plats were dusted with calcium arsenate as often as needed from the time the squares started forming until the bolls were past the stage when the weevil would damage them. No appreciable difficulty was experienced until 1941. Late in that season the migration of weevils from several adjoining acres was so heavy that it was not pos-

sible to maintain as high a degree of control as had been maintained during the 2 preceding years.

Each plat consisted of ten hills. The skips were adjusted so that each plat of an individual block had the same amount of skip. A Latin square arrangement was used in 1939 and 1940. It was necessary to reduce the number of replicates from nine to eight in 1941 because the stand was somewhat poorer.

The squares on each plat large enough for a weevil to puncture were counted each week and the desired number removed the third day after they were counted. With consideration given to other work, the weekly periods were started as near the time at which the plants averaged one square per plant as possible. Any squares that were punctured by weevils on the day the counts were made were removed but included in the total number to be removed from that individual plat.

The variety of cotton used was Cleveland 54.

Treatments

The treatments were planned to determine the reaction of the plant to the loss of squares from a weevil infestation that would rise gradually to a point where all squares were lost during the eighth week. The length of the average fruiting cycle permitted the establishment of several levels to which the percent of squares removed could be raised and maintained for the remaining part of the fruiting period. Each treatment was given a number for convenience of refer-

*Thanks are due Mr. J. F. O'Kelly and Dr. Clay Lyle, agronomist-plant breeder and entomologist, respectively, of the Mississippi Experiment Station, for their cooperation, also to Mr. W. H. Sudduth, Oktibbeha County planter, for providing cotton for part of the work.

ence. Table 1 shows the schedule of treatments.

Through treatment 6, the percent of squares removed was increased by 10 each succeeding week until the highest percent desired was reached. In treatment 7 the percent of squares removed was raised to 75 the seventh week, and in treatment 8 it was raised to 75 the seventh week and to 100 the eighth.

Squares were removed until the date on which fruiting was stopped on all plats by the removal of blooms every day or every other day. The check plats were used as an index of the time fruiting on all plats should be stopped.

Percent of Blooms Maturing Into Open Bolls

The increase in the percent of blooms maturing into open bolls (table 2) from treatment to treatment shows that one of the ways in which the plant reacts to the loss of squares is by maturing a higher percent of the bolls that are produced. In only two cases was there an average decrease in the percent of bolls set under that of a lower treatment. The decrease in one case was one percent and in the other two-tenths of one percent.

There was a decrease in the total number of blooms produced each year as the percent of squares removed was increased. This in conjunction with the increase in the percent of blooms matured into open bolls is indicative of the sensitive physiological balance that occurs within the plant and of the nutritional dominance of boll over other growth. The dominance of boll over other growth is very distinctly expressed in the case of plants that have been prevented from setting bolls by the simulation of severe cotton leaf bug damage to the small squares. Under such treatment there was a decided trend toward a shorter blooming period as the length of the period during which the squares were removed was increased.

These reactions support Ewing (3) who stated that, "At any rate, however, it is fortunate that the cotton plant produces a considerable excess of fruit buds over its needs. On this account it is evident that under certain conditions which are usually present for a variable length of time in most infested fields, the depredations of the weevils are offset wholly or in part by the reactions of the plant."

Table 1. Treatments showing percent of squares removed for 8 weeks.

Treatment	Week							
	1	2	3	4	5	6	7	8
	Percent squares removed							
Check	0	0	0	0	0	0	0	0
1	10	10	10	10	10	10	10	10
2	10	20	20	20	20	20	20	20
3	10	20	30	30	30	30	30	30
4	10	20	30	40	40	40	40	40
5	10	20	30	40	50	50	50	50
6	10	20	30	40	50	60	60	60
7	10	20	30	40	50	60	75	75
8	10	20	30	40	50	60	75	100

Table 2. Percent blooms maturing into open bolls.

Year	Treatment								
	Check	1	2	3	4	5	6	7	8
	Percent blooms maturing into open bolls								
1939	53.2	58.6	63.2	63.8	72.0	78.3	78.1	79.1	87.5
1940	66.7	74.5	76.3	80.2	86.4	91.5	92.7	93.6	96.0
1941	51.2	56.9	63.3	66.3	73.4	77.4	79.0	78.0	81.2
Av.	57.0	63.3	67.6	70.1	77.3	82.4	83.3	83.6	88.2

Table 3. Average number of bolls required to make a pound of seed cotton.

Year	Treatment								
	Check	1	2	3	4	5	6	7	8
Bolls per pound of seed cotton									
1939	91.1	88.0	85.4	83.8	81.9	79.9	80.1	81.8	79.1
1940	89.9	86.6	78.2	85.7	82.2	82.3	79.0	78.9	77.6
1941	89.2	88.9	86.0	84.3	83.8	82.6	81.8	78.6	80.1
Av.	90.1	87.8	86.2	84.6	82.6	81.6	80.3	79.8	78.9

Table 4. Average yield expressed as percent of check.

Year	Treatment								
	Check	1	2	3	4	5	6	7	8
Percent of check									
1939	100	108.9	105.3	106.8	111.8	113.1	105.0	109.8	105.2
1940	100	98.8	102.6	100.3	104.8	97.8	91.2	86.7	87.1
1941	100	96.6	101.5	103.3	99.1	94.5	91.5	92.2	77.4
Av.	100	101.4	103.1	103.5	105.2	101.8	95.9	96.2	89.9

Effect of Treatments on Boll Weight

The tendency of the plant to use more of the nutrient materials in the development of heavier bolls is shown by the number of bolls required to make a pound of seed cotton (table 3). This effect is even shown by treatment 1, which had only 10 percent of the squares removed throughout the season. It is very probable that the percent of squares removed on those plats never exceeded the natural shed.

As would be expected, a partial loss of squares affects the plant differently from that of a total loss. It is also very probable that the size of the square has some influence. In the case of the total loss of squares of the size damaged by the cotton fleahopper, there are no bolls present and the plant produces a large number of fruiting positions. If these plants are allowed to set bolls the crop is set within a shorter period than plants that have not been affected. Under such conditions the possibility of a stress period is greater than when only a partial loss of the squares occurs and the tendency is decidedly toward a production of smaller bolls. In the case of a partial loss of squares, stress conditions apparently do not occur to the extent they do on the untreated cotton, and heavier bolls are produced.

Effect of Removing Squares on Yield

Because of the small size of the plats, yields were weighed to the nearest gram. These yields are expressed as the percent of the check (table 4) because that gives a more readily understood statement of the effect of the treatments.

The yield records are indicative of the reaction of the plant to damage to the squares by the boll weevil. In 1939 the highest average yield was obtained from treatment 5, which had the percent of squares removed weekly increased from 10 the first week to 50 during the fifth week of square production. In 1940 the highest average yield was obtained from treatment 4, which had the percent of squares removed increased to 40 during the fourth week. In 1941 the highest yield was obtained from treatment 3, which had the percent of squares removed increased to 30 during the third week. It should be noted that the loss by treatment 5 in 1940 was only 2.2 percent and only 5.5 percent in 1941, also that the yield of treatment 4 exceeded that of the check in 1939 and 1940 and was within one percent of it in 1941.

The percent of blooms set and the number of bolls required to make a pound of seed cotton on the treated plats show that the plant compensates to a large

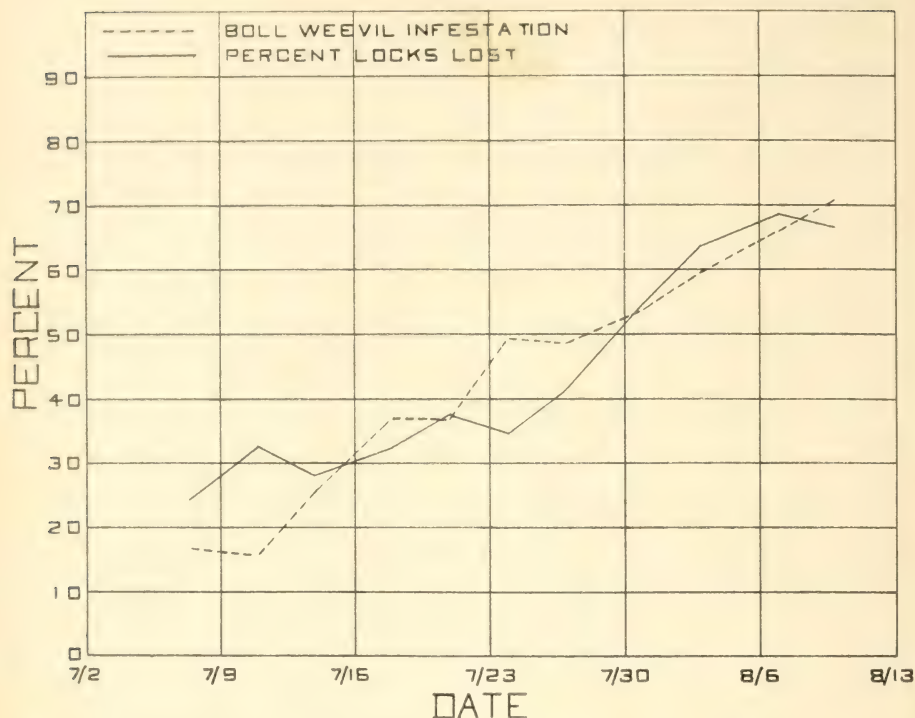


Figure 1. A comparison of the percent of locks lost during the period the bolls were susceptible to boll weevil damage with the weevil infestation on the day the bolls were marked. Average of three replicates, 1939.

extent for the loss of squares. As shown by the yield records, this reaction is such that very little gain may be expected from the protection of the squares from many of the weevil infestations that occur under Mississippi conditions.

Damage to Bolls

Although it is not the most desirable, the most practical method of obtaining an estimate of the weevil population is by the examination of a number of squares for punctures. This method being well established, it was used in the study to determine the relation between the weevil infestation and the amount of damage done to bolls set on the day the infestation record was made.

Blooms were marked with dated tags and a record of the weevil infestation

made on each day that blooms were marked. After the bolls had opened, a record was made of the number of locks in each boll and the number of locks or parts of locks lost due to weevil damage.

Figures 1, 2, 3, and 4 show the relation between the weevil infestation and the percent of locks lost. The data from which figure 4 was made were taken on cotton that had been flooded and had shed practically all of the forms that were on the plants at the time.

The average percent of locks lost for each percent of boll weevil infestation on the days the blooms were marked was 1.05 in 1939 (figures 1 and 2) and 1.1 in 1942 (figure 3). The percent lost when compared with the infestation one week after the blooms were marked was 0.82+ and 0.66—, respectively.

Figure 4 shows the loss from a very high infestation that developed late in the season (1941) following a period of 3 weeks during which the infestation did not exceed 10 percent.

Since the bolls are subject to damage during approximately the first three weeks of development it would be expected that insecticide applications for weevil control would protect the bolls set previous to the date the applications were started. The results of one year's experiments show that calcium arsenate applied as a dust is effective in lowering the percent of locks lost in bolls set during a period of 10 to 12 days previous to the date the dust was applied.

Percent of Bolls and Crop Set During Each Weekly Period of Fruiting

Regardless of whether it is more important to protect the squares or the bolls the possibility of a control measure prov-

ing profitable depends on the amount of the crop that is susceptible to damage during the effective period of the measure.

In general, the plant tends to go through a fruiting cycle of 7 to 8 weeks in the absence of heavy insect infestations and extreme weather conditions. The number of blooms produced in the absence of insect and other external damage increases weekly until it reaches a peak and then decreases as the plant approaches maturity.

Table 5 gives the average percent of blooms set during the principal weekly periods of fruiting for four varieties of cotton grown in three seasons in small plats at State College, Mississippi. The cotton was protected as much as possible from boll weevil damage throughout the season. The data in table 6 were taken by Buie (1) in South Carolina.

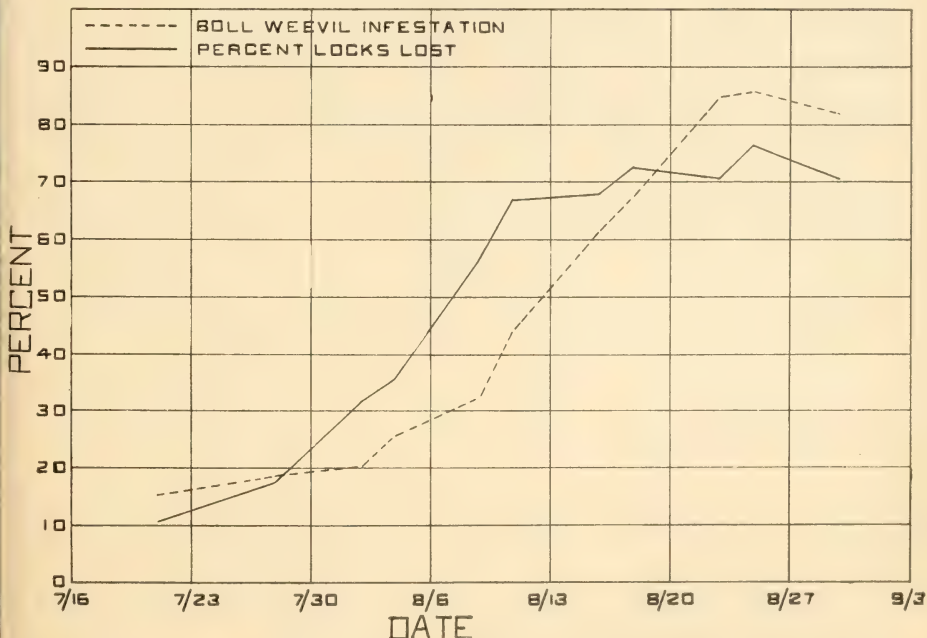


Figure 2. A comparison of the percent of locks lost during the period the bolls were susceptible to boll weevil damage with the weevil infestation on the day the bolls were marked. Average of three replicates, 1939.

Table 5. Percent of blooms set each week by four varieties.

Year	1st	2nd	3rd	4th	5th	6th	7th	8th	Variety
1939	80.5	86.0	80.5	61.5	37.0	26.5	18.0	—	Miller
1940	82.2	79.5	85.5	67.5	56.0	37.5	25.5	—	
1941	68.5	45.5	68.0	76.5	42.0	46.0	31.3	17.5	
Av.	77.0	70.3	78.0	68.5	45.0	36.6	25.0	5.8	
1939	74.0	77.0	78.5	60.5	38.0	32.0	15.2	—	Delfos 531 B and C
1940	80.5	73.5	72.5	52.0	61.5	36.0	23.0	—	
1941	64.5	53.5	66.0	83.0	46.0	34.5	19.0	16.2	
Av.	73.0	68.0	72.3	65.1	48.5	34.1	19.0	5.4	
1939	87.5	83.5	84.5	62.0	42.5	24.5	19.5	—	D. & P.L. 12
1940	87.5	82.0	88.0	58.0	59.0	43.0	28.5	—	
1941	52.0	77.0	66.5	86.5	45.0	47.0	16.5	11.0	
Av.	75.6	80.8	79.6	68.8	48.8	38.1	21.5	3.7	
1939	86.5	77.0	75.0	61.0	46.5	35.5	28.2	—	Stoneville 2B and 2B-9
1940	83.0	79.0	79.0	56.5	57.5	54.5	41.5	—	
1941	51.7	66.5	64.0	85.5	47.0	46.0	22.0	17.5	
Av.	73.7	74.1	72.6	67.6	50.3	45.3	30.5	5.8	

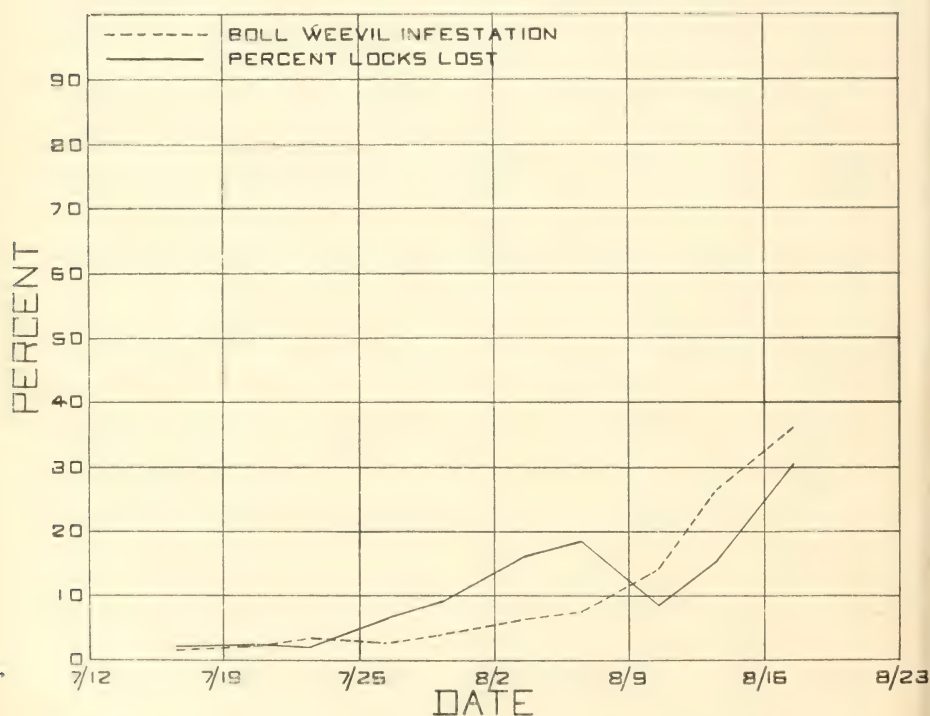


Figure 3. A comparison of the percent of locks lost during the period the bolls were susceptible to boll weevil damage with the weevil infestation on the day the bolls were marked. Average of eight replicates, 1942.

With regard to the effect of season on cotton McNamara et al (5) state that "Plant responses in a given season frequently show that there may be greater or more consistent differences in the reaction of a variety to seasonal conditions than are found between two dissimilar varieties." In any case, the number of blooms produced from week to week is an index of the maturity of the plant.

Although the percent of crop set during the weekly periods does not provide the best means whereby an estimate can be made of the need at a particular time of weevil control measures, it illustrates the importance of taking into consideration the fruiting cycle of the plant in weevil control. Table 7 shows that approximately 80 percent of the crop was

set during the first 5 weeks and over 70 percent set during the second, third, fourth, and fifth weeks.

The unstable relation between the fruiting cycle of the plant and the weevil infestation, together with the variation in the productivity of the different soils, makes it desirable to be able to estimate the amount of damage being done at any time during the season. Although the data presented herein are somewhat limited they offer a method whereby one can make a fair estimate of the amount of damage being done at a particular time. This may be determined from the average number of blooms produced per acre over a period of 2 or 3 days, the percent set expected for the period of fruiting and the boll weevil infestation. For ex-

Table 6. Summary of percent of flowers setting fruit by weekly periods throughout season (from South Carolina Bulletin 261)

Week of blooming	Percent of flowers setting fruit			
	1923	1924	1925	Average
First	82.8	79.6	97.3	86.6
Second	83.0	85.0	98.6	88.9
Third	79.6	89.9	92.9	87.5
Fourth	47.5	89.5	76.4	71.1
Fifth	50.5	64.3	23.2	46.0
Sixth	35.0	30.3	4.6	23.3
Seventh	14.8	16.0	6.2	12.3
Eighth	—	18.5	6.1	12.3
Average	51.2	53.1	40.7	48.3

Table 7. Percent of crop set each week by four varieties.

Year	Week								Variety
	1st	2nd	3rd	4th	5th	6th	7th	8th	
939	9.1	18.8	24.0	18.7	16.5	8.9	3.9	—	Miller
940	8.7	14.3	11.1	24.8	24.7	10.5	5.9	—	
941	7.7	10.7	20.6	29.7	10.2	8.1	11.2	1.6	
Av.	8.5	14.6	18.6	24.4	17.1	9.2	7.0	0.5	
939	7.4	21.0	28.0	18.4	14.1	8.8	2.3	—	
940	13.8	30.3	18.0	18.4	11.5	4.1	3.8	—	Delfos 531 B and C
941	5.0	8.9	17.7	33.4	17.3	11.7	4.9	1.0	
Av.	8.7	20.1	21.2	23.4	14.3	8.2	3.6	0.3	
939	7.6	21.2	24.4	17.5	17.7	7.6	4.0	—	
940	9.3	21.6	13.7	14.8	22.5	11.4	6.4	—	
941	2.7	10.9	16.0	32.7	16.8	15.1	5.0	0.7	D. & P.L. 12
Av.	6.5	17.9	18.0	21.7	19.0	11.4	5.1	0.2	
939	8.2	21.0	24.0	17.2	15.3	9.5	4.7	—	
940	12.9	23.4	16.2	19.6	14.3	7.9	5.6	—	
941	2.2	8.2	16.2	33.9	17.2	13.7	6.7	1.7	
Av.	7.8	17.5	18.8	23.6	15.6	10.4	5.7	0.6	Stoneville 2B and 2B-9

ample, if the plants are producing an average of 6000 blooms a day per acre during the fourth week of fruiting, one would expect them to set about 4000 bolls a day. With a 10 percent weevil infestation one would expect to lose about 400 bolls a day or 2000 during a 5-day period. Two thousand divided by the average number of bolls required to make a pound of seed cotton by the variety would give the loss expected in pounds of seed cotton for the period. At 90 bolls per pound the loss would be approximately 22 pounds per acre during the 5-day period.

Under average conditions one should

not expect an appreciable gain from weevil control measures unless the plants are producing an average of at least one bloom for 5 feet of row. During the first and last weeks of production the infestation should be at least 25 percent, in order to justify such control measures. Obviously, greater gains are to be obtained from control measures started at this infestation during the period when the plants are producing heavily. Also, on very fertile soils economical gains may be obtained from starting control measures at a lower infestation during the heavy fruiting periods because of the greater quantity of cotton being produced.

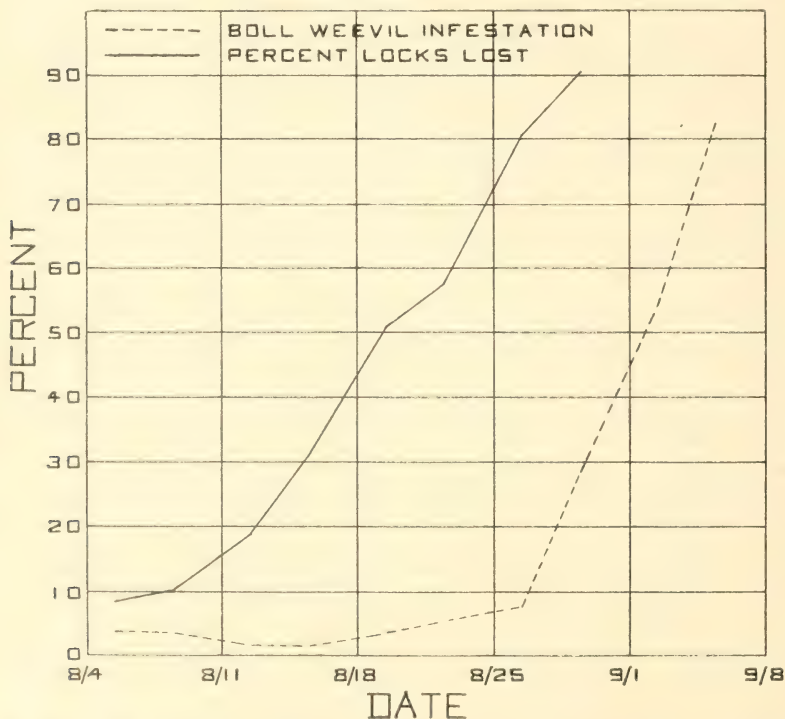


Figure 4. Effect of a very rapid increase in the boll weevil population late in the season on the percent of locks lost in bolls set before the initiation of the increase. Average of six replicates, 1940.

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Social Effects of Government Land Purchase

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SOCIAL EFFECTS OF GOVERNMENT LAND PURCHASE

By RALPH R. NICHOLS and MORTON B. KING, JR*

I. Introduction

Background

In recent years an increasing amount of land has passed from private to governmental ownership. In particular, federal agencies have acquired considerable acreage in the promotion of reclamation, resettlement, flood control, and similar projects. Where large contiguous areas—much of it in farms—are purchased, some dislocation of local life may be expected. The economy and the tax base may be disturbed, families displaced, and community activities disarranged.

Reports and rumors of such adverse results of governmental land purchase have spread. This has led to criticism of the programs which cause them. People are asking whether benefits of the projects outweigh and justify the disruption of local life. There are few data, carefully gathered by disinterested persons, which can be used in answering this question.

North central Mississippi is an area where extensive federal purchases have been made. The rivers which drain this hilly, semi-marginal area are part of the Yazoo River flood control program.⁽¹⁾ The U. S. War Department has constructed dams on the Coldwater and Tallahatchie Rivers. The war has temporarily halted plans for similar projects on the Yocona and Yalobusha. The headwaters of these streams are in the Holly Springs National Forest purchase area, a project of the Forest Service of the U. S. Department of Agriculture.

One county, Lafayette, has been particularly affected. The Sardis Reservoir (Tallahatchie River) cuts diagonally across its northwest corner.⁽²⁾ Of the 98,000 acres purchased for the reservoir, about 58 percent are in Lafayette County. Approximately 96,000 acres in its northeast corner are in the purchase area of the Forest. Of them, 35,000 acres have already been purchased. Altogether, about 20 percent of the total land area of the county is federally owned. The displacement of families and dislocation of the road system which attended the reservoir program occasioned considerable local comment, resentment, and criticism. The fact that one of the two fertile sections of the county had passed from private ownership was a central objection. When it was learned that a dam on the Yocona was contemplated, active opposition was precipitated, as such a program would require the purchase of the remaining river bottomland in the county.

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(1) See House Document No. 892, 77th Congress, 2nd Session, "Survey of the Little Tallahatchie Watershed in Mississippi", for a description of the area and an outline of the program.

(2) See map, p. 4.

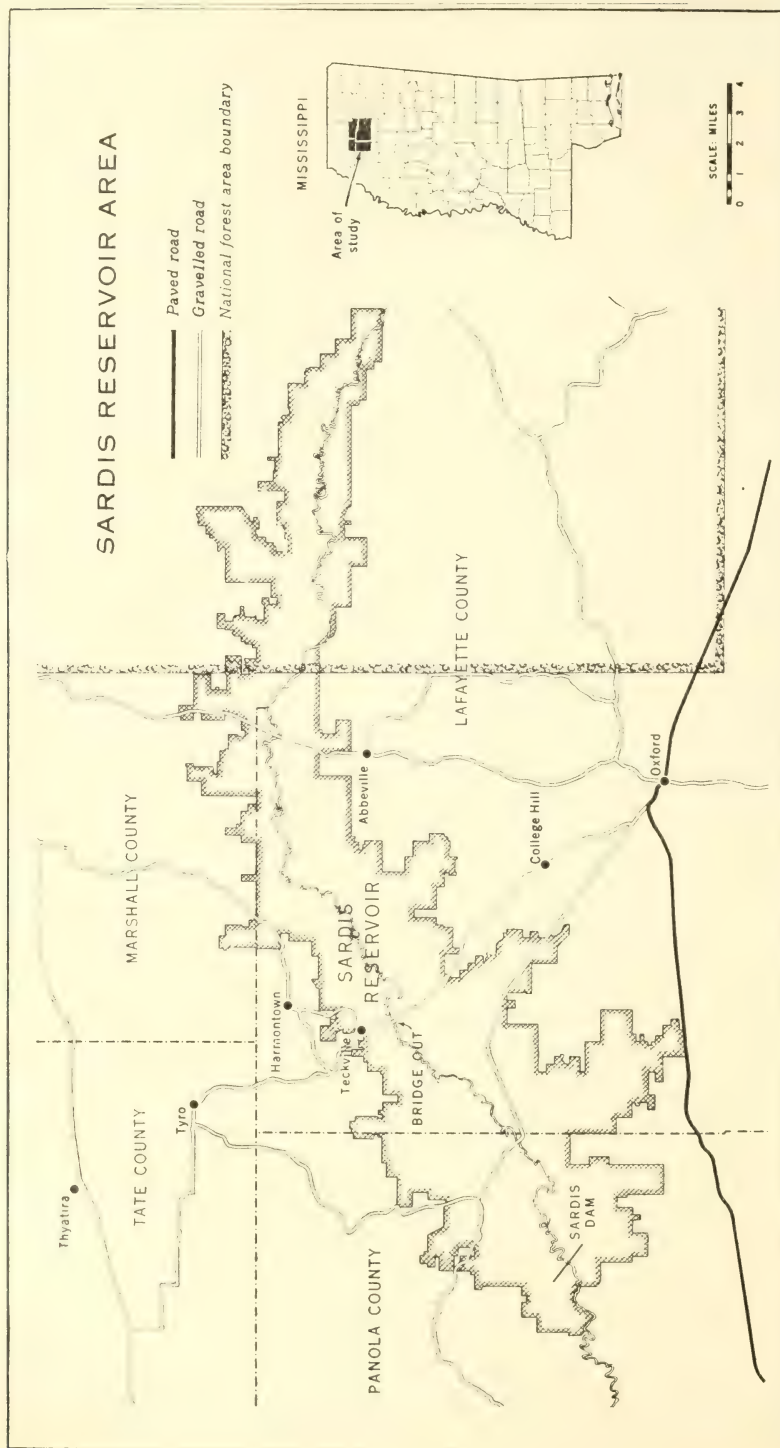


Figure 1. Sardis Reservoir Area

Purpose

Lafayette County thus provides an excellent opportunity for a study of the effects of a land purchase program. This bulletin reports such a study made cooperatively by the Mississippi Experiment Station and the Bureau of Agricultural Economics at the request of the County Agricultural Coordinating Council. The project attempts to answer two sets of questions: (1) What happened to the families who were partially or wholly displaced by the Sardis Reservoir purchase? How have their agricultural operations, economic well-being, and community relationships been affected? What adjustments have they made? How satisfactory **to them** are their adjustments? (2) What were the effects on the neighborhood, community, and institutional relationships of the areas adjacent to the reservoir?

There are many other important questions that are omitted. Chief among these is the amount of tax revenue lost to the county and the resultant effects on county governmental structure and services. Further, no attempt will be made to evaluate and judge the total desirability of the Sardis Dam and Reservoir. This must await additional and more comprehensive study. By way of conclusion, however, an attempt will be made (1) to evaluate the chief criticisms voiced by local people, and (2) to make certain suggestions regarding the conduct of future flood control projects of this type.

Of what interest or use are such facts about Lafayette County? First, they will provide a basis for the opinions of Lafayette countians toward the proposed dam on the Yocona. Second, the citizens of areas in Mississippi (and, in other states) where similar projects are proposed may find it useful to know what types of changes can be expected. Such foreknowledge may encourage and guide planning to meet expected changes. Third, perhaps the officials in charge of such purchase and construction programs may be interested to know how their actions affect family and community life as well as topography and land use.

Cooperation

It may be significant to describe the cooperation of persons and agencies which produced this study and report. Local citizens, through the County Agricultural Coordinating Council, called the problem to the attention of Station and Bureau of Agricultural Economics representatives. The field work, while planned cooperatively, was divided into two phases. The Bureau of Agricultural Economics was responsible for the part dealing with displaced families. The Station was responsible for collecting data on community and institutional adjustments. The latter phase of the project was partially supported by a grant-in-aid of research made to the Station representative by the Social Science Research Council. Each author was responsible for his portion of the field work and prepared a separate report. These are here combined into bulletin form by the Station representative. The Mississippi Agricultural Extension Service was of great aid in planning the study, and in securing local cooperation. The local Extension workers, the county superintendent of education, and many local officials and citizens extended vital help.⁽³⁾

(3) Special thanks are due D. H. Echols, Maurene L. Bickerstaff, O. D. Smith, T. D. Singleton (U.S. Engineers), and Phillip E. Mullen (The Oxford Eagle) among many others.

II. General Effects of Reservoir Project

Construction of the Sardis dam and reservoir took place between 1935 and 1939. From 1935 to 1937 local persons, employed by the War Department as appraisers, negotiated for all land to be included in the reservoir area. Practically all was secured by direct purchase without recourse to condemnation proceedings. This included the estimated area of maximum inundation, from the river itself to the 285-foot elevation. A few purchases were made beyond this line, following field or farm boundaries. As soon as purchase agreements were negotiated—and prior to payment for the land—clearing crews began removing timber below the 265-foot line. Former owners were instructed to remove all buildings from the purchase area, or have them destroyed by the Government.

The huge earth dam was completed in 1939, and the reservoir filled after that crop season. Two important roads were flooded:⁽⁴⁾ the Oxford-Sardis road connecting these two county seat trade towns, and the Oxford-Tyro road connecting the Harmontown community, northwest of the river, with Oxford, its county seat and trade center. Five country neighborhoods in Lafayette County were primarily affected. Tallahatchie, lying mainly in the bottomlands just south of the river, was almost obliterated as a neighborhood. Most of the population moved. The white school and church which formed its center had to be torn down. Negro churches and a school were moved but remain in the area. The Perkins, Free Springs, and Harmontown neighborhoods just north of the river lost population and were cut off from their service center. Most of the families moved from the Dillard neighborhood between Tallahatchie and the Panola County line.

The exact number of families in the purchase area and the proportion of them who moved could not be ascertained. Local opinion places the number affected at between 350 and 450 families. The War Department purchased 475 separate tracts of land, but had no records on families. Some farmers demolished their buildings and moved to other sections of the county, or to an adjoining county. A few went as far as the Delta, one or two to adjacent states. Many, perhaps most, moved their houses and barns to sites above the 285-foot level. There they lease "their land" back from the Government and continue to operate their farms much as before.

Much of the land in the purchase area will not be flooded except in unusually wet years, since the project is purely for downstream flood control. The War Department rents land between the 250- and 285-foot levels to farmers, former owners having first option. Cropland between the 265- and 285-foot elevations is classed as "cultivable land" and rents for 75 cents per acre per year. All land between 250 and 265 feet, with a greater possibility of inundation, is arbitrarily classed as "pasture land". This, together with pasture and woodland between 265 and 285 feet, rents for 4 cents per acre per year. Much of this "pasture" is fertile bottomland formerly planted to cotton and corn, and continues to be so used. Some former owners rent land from the Government and sub-rent it to tenants, often realizing a profit on the transaction.

The Government makes no guarantee against flooding and the

(4) See map, p. 4.

Table 1. Land purchased by Government for Sardis Reservoir and acreage leased back to private operators

County	Total land purchased	Leased back by Government (1)			
		Cropland	Pasture	Total	County total
	Acres	Acres	Acres	Acres	Pct.
Lafayette County.....	56,661.67	10,190	30,605	40,795	72.0
Panola County.....	21,955.13	2,784	9,184	11,968	54.0
Marshall County.....	20,034.67	5,003	13,554	18,557	92.0
Total.....	98,651.47	17,977	53,343	71,310	72.2

(1) U. S. War Department Engineer's records for 1941.

renter takes this risk. In case of flooding during the crop season the Government will renew the same contract for a total cost of \$1.00. There is no official information, and therefore uncertainty exists, as to the amount of flooding which can be expected. By the fall of 1941 the highest water level had been at the time of the dam's dedication in 1939. It then stood at the 254-foot elevation, flooding approximately 13,000 acres, much of it swamp and woodland which had never been in cultivation. It has been stated unofficially by government representatives that, except for emergencies, the water level will probably not be raised higher than this point.

Table 1 shows the amount of the purchase area in each of the three counties involved and the amount rented back in 1941. The percentage leased back is lowest in Panola which includes the permanent reservoir just behind the dam. It is highest in Marshall which is farthest up-stream. Of the 27,000 acres not under lease, it is estimated that less than 5,000 were regularly under cultivation before the construction of the dam.

An attempt was made to find out how much land in Lafayette County was removed from cultivation as a result of the dam. All 1941 AAA contracts which contained **any** government-owned land were examined. These 114 contracts contained 13,999 acres of cropland in 1939.⁽⁵⁾ In 1941 they included 163.6 more acres of cropland, a gain of 1.2 percent. During the same period the cropland of the county as a whole, including the land in these 114 contracts, increased from 91,284 to 96,759 acres or 6 percent. From the AAA checkers' field notes it was found that only 18 Lafayette County farms⁽⁶⁾ had been wholly **or partially covered** by water between 1939 and the end of the 1941 crop season. The cropland on these farms decreased 20 percent (from 2895.6 to 2291.4 acres) between 1939 and 1941.

While AAA "cropland" and acreage actually under cultivation are not entirely synonymous, it is clear that total acreage farmed in the reservoir area has not changed greatly from 1939 to 1941. As some bottomland was abandoned, an operator would replace it with a slightly larger acreage of land at a higher elevation. This meant replacing fertile land threatened with possible flooding (even before the dam) with less

(5) "Cropland" as defined by AAA. More inclusive than "harvested cropland." On the advice of the county agent, 1939 was chosen for comparison with 1941. 1939 was the last crop season before the dam was closed and the reservoir flooded.

(6) i. e., land under one AAA contract.

fertile "hill land"—perhaps previously regarded as plowable pasture only. Related to this is some shift from cotton and corn to hay and legumes, and a decrease in the per acre yield of land planted to row crops.⁽⁷⁾

III. Adjustments of Displaced Families

When the study was planned, it was assumed that most of the families on land purchased by the Government had moved out of the reservoir area, at least into other sections of the county. The plan was to locate samples of these families, representative as to race and tenure status. It was desired to see what problems they had faced, and how they had met them. This investigation was to be paralleled by a study of the partially truncated communities from which these families had been displaced.

Once in the field, the investigator found that many former operators of land now government owned—owners, tenants, and croppers—had not moved away from the immediate reservoir area. Some families were fortunate enough to have homes and barns above the 285-foot level and thus did not have to move at all. Some families moved short distances, still within their original or adjacent neighborhoods. Some, of course, moved to other sections of the county, and a few, farther away. All, however, had had their family life and farm operations affected to a greater or less extent. Therefore, it was decided to study a sample of **all families** who had been resident in the purchase area in 1939.

There was, however, no complete list of these families. Nor was it possible to discover the race and tenure distribution of the purchase area, since it comprises parts (only) of minor civil divisions in three counties. Use of War Department and AAA records, and notices inserted in local papers and mailed to former residents led to interviews with 157 families. When these families were compared in race and tenure with the total population of Lafayette County only slight differences are shown.⁽⁸⁾ It was the consensus of county agricultural personnel that these 157 families constituted an adequate and representative sample of the entire group affected by the purchase program and that additional interviews would not materially change the findings.

On each of these families a schedule⁽⁹⁾ was taken. The attempt

(7) See Changes in Farming Operations, p. 12 following.

(8) Race and tenure	Lafayette County (1)		Sample	
	No.	Pct.	No.	Pct.
TOTAL	3,405	100.0	157	100.0
TENURE: (2)				
Owners	1,267	37.2	65	41.4
Renters	1,169	34.3	60	38.2
Sharecroppers	969	28.5	32	20.4
RACE:				
White	2,028	59.5	91	58.0
Negro	1,377	40.5	66	42.0

(1) Mississippi Census, 1940 (Agriculture), 1st Series.

(2) Throughout this section of the report the term "owner" is applied to all owner-operators including those who rent additional land. "Renters" include cash, standing and share renters. "Sharecroppers" are distinguished from share renters by the fact that the former do not own the equipment and work stock they use. The tenure status given is that at the time of the interviews i.e., since the purchase program.

(9) See Appendix, page 54. The assistance of T. G. Standing, Bureau of Agricultural Economics, Little Rock Office, in developing the schedule and in organizing the study, is gratefully acknowledged.

was to get a picture of the families' economic and social status both before and after the purchase, to discover problems involved in resuming farm operations, and to find the interviewees' opinions on these problems and on their efforts at adjustment.

Residence and Tenure Changes

Here were 157 families who had lived on land now owned by the Federal Government. How many of them had moved, and how far? Was their tenure status, their equity in the land they worked, affected adversely?

Table 2 shows that 65 percent of the families had changed residence since the purchase program began. There had been slightly less movement in the group who are now owners than in the non-owner group. A larger proportion of white than of Negro families moved. However, most of the moves were for short distances, some only to another point on the same farm. Only about 11 percent had moved out of the county, whereas 55 percent of the total group were still residents of their original community.⁽¹⁰⁾ The majority who moved, then, went to other—often adjacent—communities in the same county, for instance, from Tallahatchie back from the river into College Hill. It seems probable that the long residence of most families in the reservoir area was an important factor in preventing the general trek to distant locations which many had anticipated.

Table 3 shows the present tenure of the 157 families with the changes in status which occurred. Only 36 families (23 percent) had changed status, there being little difference between white and Negro. However, more of the white families gained than lost status, while the opposite was true of Negroes. The greatest change occurred in the group now renters. Some rose from sharecropping to renting, while others dropped from owners to renters. This latter group are those who sold their land and are renting it back from the Government. Thus the change is largely one in name only. The present owner and cropper groups both contain a few families who rose or fell to those statuses during the period covered by the study. Most of the sharecroppers reported that they stayed with their landlord, either on the same farm or moved with him to a new

Table 2. Change of residence and previous residence of operators

Race and Tenure	Total operators	Present residence status				Previous residence						Average residence in old community Years
		Changed		Unchanged		Same community		Another (1) community		Another county		
		No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	
TOTAL	157	102	64.9	55	35.0	87	55.4	53	33.7	17	10.8	22.3
TENURE:												
Owners	65	40	61.5	25	38.4	35	53.8	21	32.3	9	13.8	28.6
Renters	60	41	68.3	19	31.6	30	50.0	24	40.0	6	10.0	18.4
Share-croppers	32	21	65.6	11	34.3	22	68.7	8	25.0	2	6.2	16.9
RACE:												
White	91	64	70.3	27	29.6	41	45.0	37	40.6	13	14.2	20.9
Negro	66	38	57.5	28	42.4	46	69.7	16	24.2	4	6.0	24.4

(1) In Lafayette County

(10) "Neighborhood" in the language of the rural sociologist.

Table 3. Change in tenure status

Race and Tenure	Total operators	Status changed						Status unchanged	
		Total		Upward		Downward			
		No.	No.	Pct.	No.	Pct.(1)	No.	Pct.(1)	No.	Pct.
TOTAL	157	36	22.9	16	44.4	29	55.5	121	77.0
TENURE:									
Owners	65	8	12.3	8	100.0			57	87.6
Renters	60	22	36.6	8	36.4	14	63.6	38	63.3
Sharecroppers	32	6	18.7			6	100.0	26	81.2
RACE:									
White	91	22	24.1	13	59.0	9	40.9	69	75.8
Negro	66	14	21.2	3	21.4	11	78.5	52	78.7

(1) Total whose status changed used as base.

Table 4. Sale of land by operators

Race and Tenure	Total operators	Land purchased by Government			
		Number selling land	Average net amount rec'd per seller	Land mortgaged	
				Farms mortgaged	Av. amt. per farm
	No.	No.	Dollars	No.	Dollars
TOTAL	157	68	6,369	27	2,169
TENURE:					
Owners	65	55	6,990	22	1,624
Renters	60	12	4,066	5	4,460
Sharecroppers	32	1	1,080		
RACE:					
White	91	48	4,303	15	3,074
Negro	66	20	509	12	935

location. Thus the impact on tenure status is less than might be expected. Only 20 families, about one-eighth of the total, changed "for the worse." Fourteen (14) of these are renters of what was formerly their own land. Their future depends on the continuation of the present favorable leasing arrangements.

Sale, Purchase, and Rental of Land

The problems arising from the sale of land and the need to acquire use of other land or to cease farming were among the most acute met by the families. Table 4 shows the number of families selling land, the mortgages on it, and the amounts received on the sale. Less than half (43 percent) of the families had sold land to the Government, the remainder being renters or sharecroppers at the time of the purchase. Of the 68 who sold land, 55 are still owners. The sellers received an average of \$8,539 each. Twenty-seven (27) of the farms were mortgaged, at an average amount of \$2,170. The average **net amount** received was \$6,369 per seller. It will be noted that those who are still owners received a larger average net return than those now non-owners. This means they had more and/or better land, and with the larger payment were able to retain their status as owners. Related to this is the fact that former owners, now renters, had larger mortgages on the average than those

who retained their ownership status. An even greater difference can be noted between the purchase payments and the mortgages of white and of Negro families.

Whether or not a seller bought other land elsewhere was largely determined by the location of his (former) farm within or adjacent to the purchase area. If his tract contained a sufficient amount of cultivable land at sufficient elevation to make flooding unlikely, he remained as a renter of the Government. Or, part of his (former) farm might be outside the purchase area, and he might continue on the same land as part owner.⁽¹¹⁾ If, however, most or all of his land were purchased and seemed liable to flooding, he sought to purchase another farm elsewhere. The absence of definite information regarding possible flooding made the choice (to stay as renter or purchase elsewhere) an arbitrary one.

Table 5 shows that 40 families had bought new land, 46 were renting privately owned land, 57 were renting land from the Government, and 24 were sub-renting land which someone else rented from the Government. To explain this last group it may be said that former owners frequently had cash, standing, or share renters on their places. The owners had priority right in leasing former holdings back from the Government. This they did, sometimes pocketing a difference as a profit. It will be noted, also, that present owners more frequently rent government land for part of their operations, while present renters more frequently rent from private owners or sub-rent government land. Thus the average part-owner pays a smaller rental than does the average renter. This lends some credence to the charge that the purchase program aided "the rich to get richer." Several of the large operators expressed themselves as highly satisfied with the leasing arrangements, since taxes and interest on mortgages were often treble the amount of present government rental costs.

The average price per acre paid by the Government for all the land it purchased was \$18.25. The average price paid by the 40 purchasers was \$17.69. The six Negro purchasers paid a smaller per acre price. This can be partly accounted for by the fact that they received less money for lands sold and that white purchasers of large acreage had prior choice of the most desirable land. The lump sum payments allowed the large majority of both white and Negro purchasers to pay all cash for their new land.

The fact that the average purchase price exceeded the selling price by about 56 cents an acre does not mean that a general, though small, unearned increment was enjoyed. On the contrary, many buyers complained that they had had to pay a high price for relatively poor land. The purchase program resulted in an increased demand for farm land in the county and thus inflated land values. The buyers, equipped with stock and tools for a certain sized operation, tended to purchase about the same or a larger acreage than they had sold and of definitely poorer quality. Many purchased quickly, trying to "beat" the inflation of values, before the present leasing arrangements were thoroughly understood. Some say this was a mistake, the operation of leased land now appearing more desirable than their present situation.

(11) Classified here in the "owner" category.

Table 5. Purchase and lease adjustments of operators

Race and Tenure	Total operators	Bought land elsewhere							Renting private land		Government land			
		Total buying		Paid all cash	Bought on terms		Total renting	Av. rent per acre per farm	Sub-renting Government land	Total renting	Av. acres rented	Av. rent per acre cropland	Av. rent per acre pasture	
		Total	Av. price per acre		No.	Dol.								Yrs.	Av. rate of int.	Pct.
				No.			Dol.	No.	Yrs.	No.	Dol.	No.	Cents	
TOTAL	157	40	17.69	32	8	12.25	5.06	46	3.38	24	57	283	.75	.04
TENURE:														
Owners	65	40	17.69	32	8	12.25	5.06	11	3.25	8	43	260	.75	.04
Renters	60							35	3.43	16	14	354	.75	.04
Share-croppers	32													
RACE:														
White	91	34	18.22	27	7	13.43	4.93	30	3.51	17	42	356	.75	.04
Negro	66	6	11.94	5	1	4.00	6.00	16	2.97	7	15	78	.75	.04

Table 6. Change in size of operators' farm land

Race and Tenure	Total acres in farms (1)			Total acres in crops			Total acres owned			Total acres rented			Total acres sharecropped		
	Total operators	Before	Now	Before	Now	No.	Before	Now	No.	Before	Now	No.	Before	Now	No.
TOTAL	157	39,191	40,523	13,484	14,651	29,836	15,235	8,399	24,909	796	819				
TENURE:															
Owners	65	30,550	28,889	9,283	9,753	25,789	15,235	4,739	13,654	22					
Renters	60	7,648	10,695	3,383	4,079	3,975		3,508	10,655	105					
Share-croppers	32	993	939	818	819	72		152		669	819				
RACE:															
White	91	33,804	34,981	10,881	12,256	26,584	13,642	6,979	21,187	221	151				
Negro	66	5,387	5,542	2,603	2,395	3,252	1,592	1,420	3,122	575	668				

(1) Both owned and leased.

Table 7. Changes in crop acreage and production(1)

Race and Tenure	Total operators	Changes in						Home garden acreage
		AAA cotton allotments	Cotton acreage	Corn acreage	Corn yield (2)	Other main crops	Pasture land	
	No.	Acres	Acres	Acres	Bu.	Acres	Acres	Acres
TOTAL	157	+322	+238	-132	-325	+576	+350	+1.33
TENURE:								
Owners	65	+133	+ 58	-145	-235	+142	+ 27	+ .08
Renters	60	+171	+162	+ 47	- 64	+433	+331	+ .25
Share-croppers	32	+ 17	+ 17	- 34	- 26	+ 1	- 8	+1.00
RACE:								
White	91	+319	+248	+108	-185	+586	+490	-1.17
Negro	66	+ 3	- 10	-240	-140	- 10	-139	+2.50

(1) Plus or minus sign indicates increase or decrease

(2) In bushels per acre.

Changes in Farming Operations

It was noted above that no wholesale withdrawal of land from cultivation occurred in the purchase area. Table 6 shows that for the sample of 157 operators both the total land in farms and the total acreage in crops increased: the former by 3.4 percent, the latter by 8.6 percent. This increase was due to a reduction of acreage planted between the 250- and 265-foot elevations and its replacement with slightly larger acreages of less fertile land "up the hill", previously regarded only as plowable pasture. This was encouraged by a desire to achieve the same total yield.

The data on acreages planted to different crops and on corn yield given in table 7 confirm this trend. The cotton allotments are larger because the total area farmed is larger. However, the fact that only two-thirds of the increased allotment was planted indicates a tendency to shift to other crops. The increase in other main crops (such as hay and legumes) bears this out. Similarly, the acreage planted to corn (and the average yield per acre) has decreased; whereas the acreage in pasture and home gardens has increased. Table A, page 45 of the Appendix, also shows that the number of milk cows decreased while the number of beef cattle increased.

Table 8. Changes in economic status

Race and Tenure	Total operators	Change in value of		Change in total debts	Net Worth		
		Farm equipment	Farm buildings		Before	Now	Change
	No.	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
TOTAL	157	+11,125	+30,285	-37,761	711,570	711,361	- 209
TENURE:							
Owners	65	+ 8,990	+33,025	-29,481	599,635	596,229	- 3,406
Renters	60	+ 2,530	- 2,590	- 8,240	106,365	110,112	+ 3,747
Share-croppers	32	- 395	- 150	- 40	5,570	5,020	- 550
RACE:							
White	91	+10,520	+29,700	-28,205	644,555	654,621	+10,066
Negro	66	+ 605	+ 585	- 9,556	67,015	56,740	-10,275

While these data are neither complete nor wholly reliable, they do show a trend among purchase families toward increased diversification and conservation practices. This is in part due, of course, to the continuing efforts of agricultural workers in the county. It appears likely, however, that among the families studied the indicated replacement of some bottomland with hill land acted to reinforce a general trend.

Equipment and Resources

An attempt was made to find the changes in value of farm equipment and buildings, in debts, and in net worth of the affected families. This was a difficult job and the methods admittedly "rule of thumb." It is felt, however, that the findings are indicative. Table 8 contains a summary of these data. The total value of farm equipment shows a net increase of \$11,125, or about \$92 per family. The greater part of this increase occurred in the owner group. The value of farm buildings increased similarly. The total debts of the group decreased, decreases occurring in all tenure and both racial groups.

Many of the owners used the proceeds from the sale of their land to build new homes and farm buildings, or to improve old ones. New and improved tenant dwellings also added to the value of "owners'" farm buildings. Some of the purchase money likewise went for new equipment. The value of equipment owned by sharecroppers showed a net loss of \$395. Although this is small, it represents 83 percent of the equipment originally owned by this group. Several of this group were renters who lost a crop due to flooding and were forced to sell their stock and tools. The 66 percent reduction in indebtedness is largely explained by the automatic satisfaction of mortgages which accompanied government purchase of encumbered farms. Hence the reduction is largest among the present owners who formerly held the larger tracts.

The change in the total net worth⁽¹²⁾ of the group as a whole is negligible. However, the total net worth of the Negroes decreased about 15 percent, while that of the white group increased 1.5 percent. The Negro decrease is partly accounted for by a reduction in the number of beef cattle, milk cows, and work stock.⁽¹³⁾ The net worth of the renter group shows a small increase of about 3.5 percent. Changes in the other tenure groups are negligible.

These group figures obscure, of course, significant changes in the circumstances of individual families, some of whom increased, whereas others decreased in net worth to an important extent. There is some indication that the financial impact of the purchase program was more unfavorable on those in the lower economic brackets. The reason in general that there was no more change in net worth is that proceeds from the sale of land were largely reinvested in farm assets or used to retire debts or establish savings. Thus they continued to exist as assets approximately equal to the original value. This is a "balancing" operation, however, only if the operator got what he thought his land was worth and if the new land was worth what he paid for it. Some operators did not think that in their cases this was true.⁽¹⁴⁾

(12) Net worth was secured by totaling the value of all assets—land (if owner), equipment, stock, and money—and deducting all indebtedness including mortgages. The value of growing or unmarketed crops was excluded.

(13) See table A in the Appendix, page 45.

(14) Tables B and C in the Appendix, page 45, give further data on changes in economic status and use of purchase money.

Table 9. Changes in average distances from services and institutions(1)

Race and Tenure	Total operators No.	To nearest neighbor Mi.	To town Mi.	To store Mi.	To gin Mi.	To county seat Mi.	To church Mi.	To grade school Mi.	To high school Mi.	To doctor Mi.	To all-weather road Mi.
TOTAL	157	+.03	+ .97	+ .18	— .52	+ 7.3	+ .51	+ .04	+1.07	+ .32	— .50
ENURE:											
Owners	65	+.13	+ .48	+ .46	— .12	+ 5.2	+ .62	+ .21	+1.30	+1.54	— .49
Renters	60	— .05	+ .23	+ .08	—1.12	+ 5.7	+ .54	— .11	+ .16	—1.02	— .46
Share-croppers	32	— .02	+3.37	— .18	— .20	+14.5	+ .20	— .02	+2.40	+ .34	— .61
ACE:											
White	91	+.04	+ .75	+ .40	— .67	+ 7.8	+ .69	— .08	+1.50	+ .41	— .44
Negro	66	+.01	+1.29	— .11	— .32	+ 6.5	+ .25	+ .21	+ .44	+ .20	— .58

(1) The figures represent the increase or decrease in distance, not the present distance.

Changes in Social Participation

One of the chief interests of this study is the extent to which social organization and family life were disrupted by the purchase program. The second phase of the report deals exclusively with this problem in one of the rural communities left truncated by the reservoir. Here we will see what the effects were among the families directly affected by the purchase program, as shown by the sample of 157 families. Conceivably, an improvement in economic status might be accompanied by adverse effects on facilities for social interaction. Added distances to services and institutions and fewer opportunities for friendly social contacts could cause dissatisfactions for which a larger bank account or ownership of more land would not compensate.

Table 9 shows the average change in the distances which the families must go to obtain various services. For the group as a whole the distances to most services increased slightly although perhaps not significantly. The average distance to town and to the county seat (partly synonymous) has increased appreciably. This is due to the flooding of roads, particularly the one leading from Harmontown north of the river to Oxford. This special case is treated in the next section of the report. Here it should be noted that the distance to towns increased most for the sharecropper group, those with the poorest means of transportation at their command.

The general decrease in distance to an all-weather road, though small, is worth commenting on. The secondary roads in the river bottoms were seldom maintained as efficiently as those "up the hill" because of periodic overflow. Thus the movement from the lowlands to higher elevations brought many of the families to or near graveled roads.

Table 10 shows the number of families who reported change in the frequency of their participation in various activities and the direction of the changes which occurred. These data are based on the recollections of the family heads and were influenced in some cases by their attitudes toward the whole governmental program. This circumstance makes the bias in the direction of overemphasizing the effects of displacement. Within these limitations some idea may be obtained of the changes which resulted. It will be seen that the great majority of families reported no change in their activities. In four of the seven types of participation

studied, over 90 percent of the families reported no change. These four types were attendance at all types of organizations, attendance at farm meetings separately, attendance at movies, and number of days' work exchanged with neighbors. Changes are reported by about 30 percent of the families in monthly church attendance, number of family visits, and trips to town per month.

For those families reporting changes, some increase in the number of visits to town and in movie attendance occurred, the latter following from the former. The increased proximity to all-weather roads and 20 percent increase in the number of autos owned by the group⁽¹⁵⁾ indicate that the purchase program helped bring this about. However, the growing importance of agricultural programs has necessitated increased contact with county agricultural personnel. Also, the purchase itself required considerable travel to Oxford to settle details of title clearance, payments, etc., by former owners. All other changes were decreases. These were largest in the church attendance, family visiting, and work swapping of the white-owner group. How much of this decreased participation among the 10 to 30 percent of families reporting changes was due to the purchase program and how much to general trends typical of most rural areas cannot be determined.⁽¹⁶⁾

It may then be concluded that only slight increases occurred in the distances which the families must travel for goods and services and that the pattern of social participation of most families was little affected by the purchase program.

Attitudes and Opinions

In addition to the more objective facts already presented about displaced families, it was thought important to obtain a personal evaluation of the displacement and adjustment experience from the families themselves. This was done by asking the family head during the latter part of the interview what the chief problems were which his family had faced, whether or not he felt they had been fairly treated, if unfairly in what way, and whether they felt themselves better or worse off than before,

(15) Table C in the Appendix, page 45.

(16) See table D in the Appendix, page 46 for participation in public affairs.

Table 10. Social participation

Race and Tenure	Total operators	Total organizations attended			Monthly church attendance			Yearly farm meetings attended		
		Re-mained same	Average now	Average change	Re-mained same	Average now	Average change	Re-mained same	Average now	Average change
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
TOTAL	157	141	1.49	—08	117	2.05	—30	140	1.69	—07
TENURE:										
Owners	65	57	1.65	—18	48	2.08	—31	56	2.29	—14
Renters	60	54	1.52	—03	44	1.92	—38	52	1.60	—03
Share-croppers	32	30	1.12	—06	25	2.25	—12	32	.62	.....
RACE:										
White	91	78	1.64	—13	62	1.80	—45	75	2.42	—08
Negro	66	63	1.29		55	2.39	—09	65	.68	—06

Table 11. Operators' problems after displacement

Race and Tenure	Total operators	Most difficult problem							No problem
		To find other suitable location	To find good land	To find land within price range able to pay	To find satisfactory landlord	Physical problem of moving	Tear down and rebuild house or buildings	All other	
	No.	No.	No.	No.	No.	No.	No.	No.	No.
TOTAL	157	39	10	6	6	7	7	13	69
TENURE:									
Owners	65	25	2	5			2	7	24
Renters	60	11	6	1	5	2	5	3	27
Sharecroppers	32	3	2		1	5		3	18
RACE:									
White	91	30	7	3	2	2	3	8	36
Negro	66	9	3	3	4	5	4	5	33

and why. The unusual opportunity to "unburden" one's self to a government representative under a pledge of anonymity seemed to produce uninhibited discussion. While many answers were biased and emotional, all together serve to give a rough indication of the opinions and feelings of the families affected.

Table 11 classifies the answers to the question "What was the most difficult problem you had to face?" Of the 157 family heads, 44 percent reported they had had no difficult problem in connection with the displacement. The percentage among those answering "No difficult problem" was highest among sharecroppers and Negroes, lowest among present owners. It was noted above that most croppers stayed with their landlords in the same relationship; thus little adjustment was required. The chief problem mentioned by this group was the physical task of moving. However, the reticence of Negroes accounts for part of these apparently "favorable" reactions. The most frequent complaint of the owners was their difficulty in finding another suitable location. Most important to the renters reporting difficulties were finding a suitable location and finding good land, which in many cases were synonymous.

Table 10. Social participation (continued)

Family visits per month			Trips to town per month			Movies per month			Average days work exchanged		
Re- mained same	Aver- age now	Aver- age change	Re- mained same	Aver- age now	Aver- age change	Re- mained same	Aver- age now	Aver- age change	Re- mained same	Aver- age now	Aver- age change
No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
112	4.55	— .72	116	3.57	+ .27	145	.68	+ .06	141	3.69	— .48
40	4.09	— 1.38	52	4.23	+ .41	63	.65	+ .03	58	2.52	— 1.17
45	4.98	— .45	38	3.58	+ .30	51	.87	+ .10	53	4.82	— .17
27	4.66	+ .13	26	2.19	— .09	31	.37	+ .03	30	3.97	+ .31
60	4.45	— .95	61	4.46	+ .47	80	1.05	+ .09	77	4.20	— .94
52	4.68	— .41	55	2.33	— .02	65	.15	+ .02	64	3.00	+ .15

Table 12 shows the number of operators who felt they had been fairly or unfairly treated by the purchasing agency. Only 96 replied to the question, the rest being renters or croppers who had little direct contact with the federal authorities. Of these, 53 felt they had been fairly treated, 43 that they had not. There are, however, interesting differences between the tenure and racial groups. A majority of the present owners felt they had been unfairly treated, while a large majority of present renters and sharecroppers felt they were fairly treated. The white operators were about equally divided in opinion, but only a third of the Negroes reported unfair treatment. Here again the response of a Negro to a white interviewer must be considered in interpreting the answers. It must not be thought that the 53 persons reporting fair treatment were necessarily in sympathy with the purchase program or that they had no difficulties and complaints. One may conclude, however, that 55 percent of those replying to the question felt they had not been subjected to discrimination, partiality, or unethical procedures by the federal representatives.

Table 13 summarizes the 62 reasons why the 43 operators felt they were treated unfairly. Most of them fall into 10 categories. The most frequently mentioned complaints were a delay in payment of the purchase price, and a purchase price which was considered too low. As soon as the sales agreement was signed, the Government assumed all the rights of ownership. However, payment was not made until the legal title was cleared by carrying the abstract back to the original Indian owners. At the time of the study, late 1941, several sellers had not yet received payment, and many reported that their payments had been delayed two to three years. No interest was paid on the purchase price from the time the land was relinquished for government use until final payment was made.

Former owners were asked, point blank, if they thought they had received a fair price for their land. Forty-seven (47) percent said that they had not. The average per acre price paid by the Government for the entire 98,000 acres (the sample families account for an estimated 26,200) was \$18.25. The average value of farm land per acre (including buildings) was \$13.43 in 1940 for Lafayette County as a whole.⁽¹⁷⁾ Neither of these figures is completely applicable to the sample families. The Tallahatchie

(17) Mississippi Census, 1940 (Agriculture), 1st Series.

Table 12. Operators' opinion of treatment by Government

Race and Tenure	Total operators	Fairly treated by Government?		
		Yes	No	No opinion
	No.	No.	No.	No.
TOTAL	157	53	43	1
TENURE:				
Owners	65	26	36	1
Renters	60	18	6	-
Sharecroppers	32	9	1	-
RACE:				
White	91	32	31	1
Negro	66	21	12	-

Table 13. Reasons for feeling unfairly treated by Government

Race and Tenure	Total report- ing "un- fair treat- ment"	Delay in pay- ment	Misrepre- sentation of facts by Gov't.	Pressure through threat of condem- nation	Price too low	Discrimi- nation by Gov't. representa- tives	Policy regard- ing timber not clearly defined	Destruc- tion of crops	Destruc- tion of fences	Refusal of Gov't. to pur- chase entire tract	Broken promises of Gov't. repre- senta- tives	All other
		No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
TOTAL	43	17	4	9	16	1	2	3	2	1	1	6
TENURE: Owners	36	15	4	9	14		1	3	2	1	1	4
Renters	6	1			2	1	1					2
Share- croppers	1	1										
RACE: White	32	12	3	6	10	1	2	3	2			6
Negro	12	5	1	3	6					1	1	

Table 13. Reasons given by operators for feeling unfairly treated by Government

Race and Tenure	Total opera- tors report- ing "worse off"	Worse off finan- cially	Work- ing less land	Work- ing poorer land	Less oppor- tunity for making money	Insecu- rity of leasing arrangement	Incon- venience of com- munity services	Greater distance to center	Displace- ment from old home	Sale price unsatis- factory	Took all good land	All other
		No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
TOTAL	67	7	6	21	6	4	3	2	4	5	7	41
TENURE: Owners	38	6	4	13	2	1	1	1	3	5	6	21
Renters	21	1	2	5	3	3	1		1		1	15
Share- croppers	8			3	1		1	1				5
RACE: White	40	7	3	11	3	1	3	1	3	5	3	25
Negro	27		3	10	3	3		1	1		4	16

bottomland is some of the best in the county. Indeed, the Government paid over \$60 per acre for some of it. The validity of the contention that the price was too low will be considered in the Conclusion.

Third in importance as a reason for feeling unfairly treated was what may be called "pressure through threat of condemnation." This was expressed in many ways but most simply by those who said, "There just wasn't anything I could do about it." It was felt that the purchase program was begun without their consent and proceeded inexorably regardless of public and individual opinion. Owners were asked to set a price on their land. Appraisers countered with lower offers and endeavored to reach a compromise. When, as frequently happened, negotiations reached an impasse, all that was needed to secure an agreement was to mention the only alternative—condemnation. Many former owners stated that regardless of the price actually received, and even when the opportunity to sell was not unwelcome, they were conscious of a feeling of resentment at their helplessness in the situation.

A few persons mentioned misrepresentation of facts by federal representatives and the destruction of crops and fences by construction workers as additional reasons for resentment. Other widely scattered reasons were given. The fact that two-thirds of all complaints fall under the first three categories discussed above would indicate that these were of primary importance in the minds of those operators who felt unfairly treated.

All of the 157 interviewees were asked, "Do you feel that you are now better off, about the same, or worse off than before the purchase program?" and "Why?" Table 14 gives the answers to the first question. About 17 percent of the total group felt that they were better off. Forty (40) percent said they considered their general condition about the same. A slightly larger percent, 43, stated they were worse off than formerly.

Over half of those who thought they had benefited from the program are former owners who are now renting. They gave three main reasons, all economic. Some just stated they were "better off financially"; whereas others said that their present rental (government) was less than taxes had previously been or that they had paid off large mortgages. The majority (59 percent) of those who are now owners felt that they were worse

Table 14. Operators' opinions of their present status

Race and Tenure	Total operators	Better than formerly		Present status about the same		Worse than formerly	
	No.	No.	Percent	No.	Percent	No.	Percent
TOTAL	156	26	16.7	63	40.4	67	42.8
TENURE:							
Owners	64	8	12.5	18	28.2	38	59.2
Renters	60	15	25.0	24	40.0	21	35.0
Sharecroppers	32	3	9.4	21	65.6	8	25.0
RACE:							
White	90	17	18.9	33	36.7	40	44.4
Negro	66	9	13.6	30	45.5	27	40.9

off, with the sharecroppers midway between the other two groups. There is no great difference between the answers of white and Negro families. These figures seem to indicate that former owners who bought new farms or new land to go with part of their old ones felt more severely the impact of the purchase program than did those former owners who, freed of debt, are renting back "their land" from the Government.

Table 15 gives the reasons advanced by those who felt that they were worse off as a result of the purchase program. Sixty-seven operators mentioned 106 different complaints, two-thirds of which can be classified under 10 headings. The most frequent reason was that they were now "working poorer land." This was also mentioned by many who reported their general status "about the same." Related to this complaint were others frequently mentioned: "the Government took all the good land" and "less opportunity for making money." Next most frequently mentioned was just plain "worse off financially"; and, in explanation of that, "unsatisfactory sale price." Last of the economic reasons was "insecurity of present leasing arrangement." Three non-economic reasons were offered by a few: "displacement from old home", "inconvenience of present community services," and "greater distance to trade center." There are no important differences between the answers of the various tenure and racial groups.

Summary

About 40 to 50 percent of all the families who lived on land purchased by the Federal Government for the Sardis Reservoir are included in this sample of 157. Their sales of land account for about 26,000 of the 98,000 acres purchased. The family heads were interviewed to find out any changes in farm operation, economic status, and family activity which had occurred. They were also asked to tell the major problems they had had to face and their attitudes toward these problems and the purchase program as a whole.

Approximately two-thirds of the families had changed residence. For many of these the move was to higher elevation on the same farm unit. Eighty-nine (89) percent of all moves were within the same community or to another community (often an adjoining one) in the same county. There was only minor movement (11 percent of all families) out of the original county. About 25 percent of the operators changed their tenure status. About half of these, 13 percent of the total, "declined" in status. Practically all the changes from owner to renter are cases in which the previous owner is leasing "his land" from the Government and operating it practically as before. Thus much of the "decline" in tenure status is of little significance.

About 43 percent of those interviewed had sold land to the Government. The average gross amount received was \$8,540, and slightly less than 40 percent of the farms were mortgaged. The average selling price was \$18.25 per acre. About 25 percent of the operators, 59 percent of those who had sold farms, purchased new land, practically all within their county of residence. The average purchase price was \$17.69 per acre. Much of the land so purchased was of poorer quality and less productive, and was bought at a somewhat inflated price.

The total land farmed and in crops by the 157 operators has increased

slightly. This increase is chiefly due to the danger of cultivating some (a small percentage) of the bottomland now in the purchase area and its replacement with a larger acreage of less fertile hill land. This change was accompanied by a slight loss in productivity and by some changes in type of crops grown. Corn acreage declined; a smaller proportion of larger cotton allotments was actually planted; more hay and legumes were planted; and more beef cattle raised. Cotton and corn productivity declined. The purchase program seems to have accelerated for these operators the trend toward diversification already under way in the area.

A comparison of the economic resources of the operators now and before the purchase program shows that the value of their farm equipment has increased 17 percent; and the value of their farm buildings, 33 percent; whereas their debts have decreased approximately 66 percent. The total net worth of the operators remains practically unchanged, although there are numerous cases of large individual changes. The Negro group particularly have suffered a considerable reduction in net worth partly because of a decline in number of livestock owned, and partly because of lowered returns from sharecropping less productive land. The economic status of the operators as a whole may be said to have been little affected by the purchase program.

The social participation of the families was somewhat affected in a few instances. The average distance traveled for most activities increased slightly. This increase was particularly true for families in one or two areas now partly isolated by the reservoir. The average family is now closer to an all-weather road, though farther from the county seat than before. Only 10 to 30 percent of the families reported any change in the frequency of their participation in various activities. For these, a majority of whom are white owners, there was some decrease in the frequency with which they attended church, swapped work, and visited neighbors. However, there was an increase in the number of visits to town per month. Not shown is the extent to which different stores, churches, schools, etc., are now patronized.

About 45 percent of the operators reported that the purchase program did not cause them any difficult problem of adjustment. About two-thirds of the owners, however, listed difficult problems they had to face. Of those operators who had had direct dealing with federal representatives, the former owners, 45 percent felt they had not been fairly treated. While the white operators were about equally divided in opinion, only a third of the Negroes felt unfairly treated. More present owners mentioned unfair treatment than other tenure groups. The main complaint was the delay in payment after the Government took possession and while the title was being cleared. Although the delay was two to three years on the average, no interest was paid. Other complaints were that the purchase price was too low (made by 47 percent) and that the threat of condemnation was used.

About one-sixth felt they were better off as a result of the purchase program either because of better financial circumstances, relief from taxes, or the retirement of mortgages. Most of this group were former owners now renting government land. About 40 percent of the group reported their condition "about the same," while the remaining 43 percent maintained they were definitely "worse off." Over half of those so reporting

are present owners. Economic reasons were the main ones given for feeling "worse off." Most frequently mentioned were that they were working poorer land, were working less land, and had less opportunity to make money.

An evaluation of the validity of these and other complaints made by local people is reserved for section one of the Conclusion.

IV. Community and Institutional Adjustments ⁽¹⁸⁾

This section of the study deals with the effects of the reservoir and purchase program on the neighborhood, community, and institutional relationships of the area adjacent to the reservoir. What happens to neighborhoods and communities when some of their members move out? How are churches and schools affected? What happens to existing trade, service, and "neighboring" activities?

The time and money allotted for field work suggested an intensive study of a small area and population. After visits and talks with local leaders in all parts of the reservoir area, the northwest corner of Lafayette County, known as the Harmontown community, was selected. The impact of the program here was midway between slight and extreme, except for the flooding of its main road connection with Oxford.

The Harmontown area had been delineated for the Land Use Planning Program as a community comprising three neighborhoods. About equidistant from three county seat trade centers and having some sense of local unity, the area is justifiably considered a country community.⁽¹⁹⁾ It centers mainly on the hamlet of Harmontown which gives its name to one of the neighborhoods as well as to the whole community.⁽²⁰⁾ Here is located an excellent general store, well managed with up-to-date stock from groceries to farm machinery and furniture; a gin; a grist mill; two small furnish stores; a filling station that handles some groceries plus cold drinks, ice cream, etc.; and a barber-shop, open Saturdays only. The Harmontown Baptist Church is also located here.⁽²¹⁾ One mile south, the Free Springs Methodist Church is the single objective focus of the neighborhood by that name. A Negro Free Springs Church (Methodist) and a one-teacher elementary school are the center of the Free Springs Negro neighborhood, which also includes the Negroes living in Harmontown (white) neighborhood. The Perkins School (elementary and high school) takes its name from that neighborhood, but serves the entire community. Across the road is the Oak Grove (Christian) Church; and one and one-half miles south, the New Hope Baptist Church.⁽²²⁾ At the

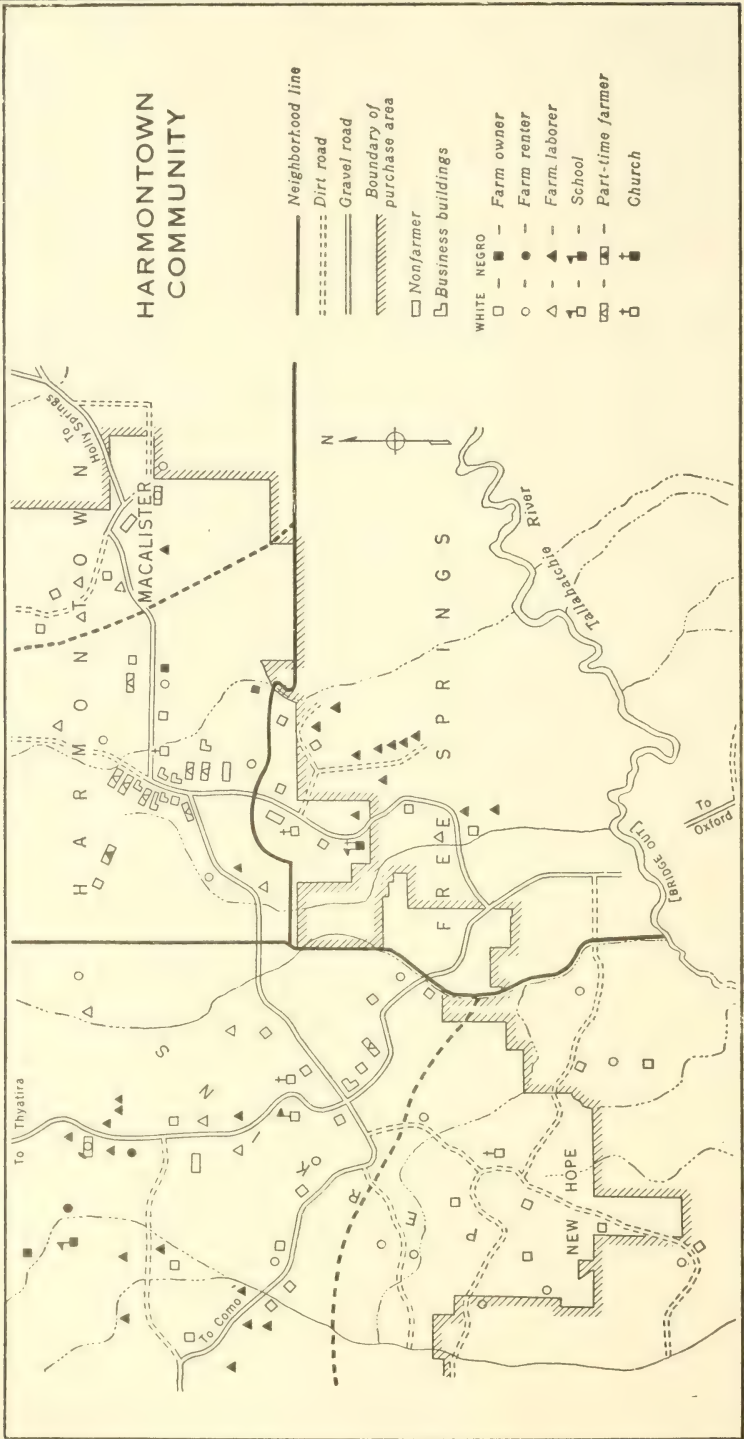
(18) The field work upon which this section is based was financed in part by a grant-in-aid of research from the Social Science Research Council to the Station representative. He wishes to make grateful acknowledgment of this assistance.

(19) Sanderson, *Social Areas of Otsego County*, Cornell Agr. Expt. Sta. Bulletin No. 422, p. 28. An area with less than complete services, distinguished from the town-country or "rurban" community. The term neighborhood is used in this section to refer to a small group of country families in more or less intimate "neighboring" relationship with each other.

(20) See map, page 24. Hereafter, the phrase "at Harmontown" will refer to the hamlet; "in Harmontown", to the whole community, and "Harmontown neighborhood", to that subdivision.

(21) Ten families in the extreme eastern part of Harmontown neighborhood make up an area once known as MacAlister neighborhood, integrated around a one-room school long since abandoned.

(22) This, with a now abandoned elementary school, was once the center of a neighborhood by that name, and the families of this area still retain some feeling of separateness from Perkins as a whole.



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Figure 2. Harmontown Community

crossroads just south of the school are a store and grist mill recently moved (because of the reservoir) from a location in Free Springs on the (old) road to Oxford. In the northwest corner of Perkins, is another one-teacher Negro school, Rush. It seems to be a subordinate center in a Negro neighborhood, most of which lies in Panola County.

An attempt was made to interview all families in Harmontown. It is believed that four families, two white and two Negro, were all that were missed. A schedule ⁽²³⁾ (see Appendix pages 51 to 53) was taken from 112 family heads. Table 16 shows the distribution of these families by neighborhood and race. It will be noted that although Negroes compose about one-third of the total they are concentrated in Free Springs and the northern part of Perkins. Indeed, Negro families are a majority in Free Springs. This racial distribution should be remembered in interpreting the data to follow.

Two main types of information were sought. First, the interviewee's opinions were obtained on what, if any, effect the purchase program had had on the activities of his family and his neighborhood. Second, a "before and after" picture of his family's trade, service, and "neighboring" activities was obtained. In addition, general information was secured in informal conversations. Proprietors of all businesses in the area, representatives of all churches, and a teacher or board member of the schools were visited. Other data were supplied by the county agents and the county superintendent of education.

Local Opinion of Effects of Reservoir Program

How Were Families Affected? Each family head interviewed was asked if the activities of his family had been in any way changed by the purchase program and the reservoir. He was asked to select one of six answers: YES, meaning changes neither helpful nor harmful; HELPED; HURT; BOTH, meaning changes some helpful, some harmful; NO CHANGE; and DON'T KNOW. The answers obtained to this question represent the experiences of families as interpreted by them. They are

(23) This schedule served a double purpose. It was also used to gather data for a theoretical analysis of community relationships which is being made separately.

Table 16. Number of families in each neighborhood, by race

Neighborhoods	Negro	White	Total
	No.	No.	No.
Perkins (total)	15	40	55
North part	15	25	40
New Hope	—	15	15
Harmontown (total)	7	26	33
Harmontown	5	18	23
MacAlister	2	8	10
Free Springs	14	10	24
.....	—	—	—
Total	36	76	112

Table 17. Number of families reporting changes, by neighborhood

Change	Perkins		Harmontown		Free Springs		Total	
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
Yes	1	1.4	1	3.0	2	8.3	4	3.6
Hurt	9	16.7	13	39.4	6	25.0	28	25.0
No change	45	81.9	19	57.6	15	62.5	79	70.5
Don't know					1	4.2	1	0.9
Total	55	100.0	33	100.0	24	100.0	112	100.0

Table 18. Number of families reporting changes, by race

Change	Negro		White		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Yes			4	5.3	4	3.6
Hurt	3	8.5	25	32.9	28	25.0
No change	32	88.7	47	61.8	79	70.5
Don't know	1	2.8			1	0.9
Total	36	100.0	76	100.0	112	100.0

Table 19. Number of families reporting changes by occupation

Change	Owners		Renters		Laborers		Non-farmers*	Total	
	No.	Pct.	No.	Pct.	No.	Pct.	No.	No.	Pct.
Yes	2	4.7	2	9.1				4	3.5
Hurt	15	34.9	5	22.7	3	7.7	5	28	25.0
No change	26	60.4	15	68.2	35	89.7	3	79	70.5
Don't know					1	2.6		1	0.9
Total	43	100.0	22	100.0	39	100.0	8	112	100.0

*Percentages are not given where total number of cases is very small.

what people **think** has happened to them. Tables 17, 18, and 19 display the answers, arranged by neighborhood, race, and occupation.

Approximately 30 percent reported their family life affected one way or another. None said they were helped; 25 percent said their family life had been hurt; and 4 persons reported changes which they were unable or unwilling to describe as either helpful or harmful. The percentage of families reporting changes was lowest in Perkins (17 percent), highest in Harmontown (40 percent). Only 3 out of 36 Negro families reported changes of any kind, all harmful. On the other hand, approximately 33 percent of the white families reported adverse changes. How much of this difference is due to a differing impact of the project on the races and how much to reporting errors is hard to assess. Five of the eight non-farm families reported their family life adversely affected. Of the farm groups, 35 percent of the owners, 23 percent of the renters, and 8 percent of the laborers⁽²⁴⁾ so reported. It should be noted that 30 of the 39 laborers are Negro.

Those persons who had noted changes in family life were then asked to specify the nature of the change. Table 20 displays the answers. Only the changes thought "harmful" are listed. Twenty-eight (28) persons reported 32 such changes. Ten persons, the largest number, said they had been adversely affected by the closing of the high school⁽²⁵⁾ and consequent transportation of their children into an adjoining community to school. Eight persons mentioned that they had changed their farming operations. Because they sold their bottomland to the Government, they now had to rent it back on a year-to-year basis or replace it with larger acreages of hill land. Other families felt that they had been disadvantaged by churches suspending or curtailing activities, going farther to trade now that the direct road to Oxford was closed, losing close

(24) Owners and part owners are grouped together. Non-owners who direct (within the terms of their lease) their operations are classed as renters—whether they pay cash, standing, or share rent. Day hands, sharecroppers, and so-called share tenants (where they are closely supervised by real operators) are classed together as laborers. See Smith, *Sociology of Rural Life*, 1940, pp. 266-270.

(25) Seventeen families reported they had children in high school.

Table 20. Harmful family changes reported

Change	Families	
	No.	Pct.
High school	10	35.7
Farming	8	28.6
Kinfolks	4	14.3
Roads-Trade	3	10.7
Business	3	10.7
Church	2	7.1
Moved	2	7.1
Total persons	28	*

*Since some persons listed more than one change, the percentages do not equal 100.

touch with relatives who had left the community, having their store or other non-agricultural business hurt, and being forced to move. The figures are too small to reveal significant race or occupational differences.

How Were Neighborhoods Affected? Each interviewee was also asked what changes, if any, the Government project had caused in the life and activities of his neighborhood.⁽²⁶⁾ He was first given the same

(26) The answers below will make apparent the fact that the interviewees answered this question with both their own neighborhood and the community as a whole in mind.

Table 21. Number reporting neighborhood changes, by neighborhoods

Change	Perkins		Harmontown		Free Springs		Total	
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
Yes	1	1.4	4	12.2	5	20.8	10	8.9
Hurt	50	91.0	27	81.8	6	25.0	83	74.1
No change	4	7.6	2	6.0	12	50.0	18	16.1
Don't know					1	4.2	1	0.9
Total	55	100.0	33	100.0	24	100.0	112	100.0

Table 22. Number reporting neighborhood changes, by race

Change	Negro		White		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Yes	3	8.5	7	9.2	10	8.9
Hurt	14	38.9	69	90.8	83	74.1
No change	18	49.8			18	16.1
Don't know	1	2.8			1	0.9
Total	36	100.0	76	100.0	112	100.0

Table 23. Number reporting neighborhood changes, by occupation

Change	Owners		Renters		Laborers		Non-farmers	Total	
	No.	Pct.	No.	Pct.	No.	Pct.	No.	No.	Pct.
Yes	4	9.4	2	9.1	33	7.7	1	10	8.9
Hurt	38	88.3	19	86.4	19	48.7	7	83	74.1
No change	1	2.3	1	4.5	16	41.0		18	16.1
Don't know					1	2.6		1	0.9
Total	43	100.0	22	100.0	39	100.0	8	112	100.0

six choices as above, and then asked to specify. Tables 21, 22, and 23 display the answers by neighborhood, race, and occupation. Only 16 percent of those interviewed said there had been no change in neighborhood life. Approximately 75 percent said their neighborhood had been adversely affected. The percentage so reporting was highest in Perkins (91 percent), especially in New Hope along the reservoir edge, where 100 percent of the respondents said the neighborhood had been "hurt." Fewest changes were reported in Free Springs. There, 50 percent said "No change", while 25 percent reported harmful changes. Free Springs borders the reservoir, as does New Hope, but has a higher percentage of Negro population. All of the white interviewees said some change in neighborhood life had occurred. Ninety (90) percent thought it was for the worse. Only about half of the Negroes said there had been some change; 39 percent said it had been harmful. Here again is doubt as to the meaning of this racial difference. We do not know whether: there was little harm to Negro activities; Negroes were not aware of changes that had occurred; or they were afraid or unwilling to so report.⁽²⁷⁾ A large percentage of the farm owners and renters, together with nonfarmers, reported adverse effects to the neighborhood. Percentages ranged from 85 percent to 90 percent. About half the farm croppers and day hands, most of whom are Negro, said neighborhood life had been "hurt." Forty-one percent of the laborers said there had been no change in neighborhood life, while negligible numbers of owners and renters and no nonfarmers so stated.

The local residents interviewed were also asked to list the specific changes in neighborhood activities they thought had occurred. Since the majority of changes were thought to be harmful, only such answers are given. Tables 24 and 25 give the harmful changes reported by 83 persons, classified by race and occupation.

Church, school, and trade (including road abandonment) were mentioned most frequently. Approximately 81 percent of the 83 persons said the churches had been "hurt." Loss of the financial and "moral" support of leading members who moved was said to have forced the churches to discontinue services or to carry on the same or inferior services with increased burdens on remaining members. Seventy-seven (77) percent said schools were adversely affected. The preponderance of these were white persons who referred to loss of the high school with the attendant transportation problems mentioned above. Fifty-three percent mentioned changes in roads within the community and especially between it and the county seat, with consequent hardships and dislocations in trade relations. Some reported poorer local roads, especially in New Hope along the reservoir. About 34 percent made the general complaint that "lots of people had to move away." Other changes mentioned by from 1 to 5 persons were: Harm to farming operations, harm

(27) Nor do we yet know the extent to which white and Negro persons feel attachment to the same or to different locality groups. Negroes may "belong" to (that is, have certain consciously recognized relationships in) a white dominated neighborhood. Or, they may be aware of the fact that they have a different and separate neighborhood group of their own. Or, they may "belong" to a white dominated and a Negro neighborhood group at the same time. These, and other situations will probably be found to vary by locality—depending on type of farming and tenure institutions, percentage of Negroes in total population, etc. Observation suggests that "neighborhood" is a two-way affair for Harpnotown Negroes. Trade relationships give them participation in community activities. In the economic, personal, and dependency relationships of farming they are part of the pattern of the "white" neighborhoods. And in addition, church, school, and informal sociability are the bases for a purely Negro group. If this is so, it is not clear to which neighborhood Negroes have referred in the above question.

Table 24. Harmful neighborhood changes reported, by race

Change	Negro		White		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Church	11	78.6	56	81.2	67	80.7
School	3	21.4	61	88.4	64	77.1
Roads-Trade	7	50.0	37	53.6	44	53.0
People moved	4	28.6	24	34.8	28	33.7
Farming			5	7.2	5	6.0
Business	1	7.1	4	5.8	5	6.0
Lost neighbors			2	2.9	2	2.4
Loss of tax base			1	1.4	1	1.2
Total persons	14		69		83	

Table 25. Harmful neighborhood changes reported, by occupation

Change	Owners		Renters		Laborers		Non-farmers Number	Total	
	No.	Pct.	No.	Pct.	No.	Pct.		No.	Pct.
Church	32	84.2	15	78.9	15	78.9	5	67	80.7
School	35	92.1	15	78.9	8	42.1	6	64	77.1
Roads-Trade	21	55.3	10	52.6	9	47.4	4	44	53.0
People moved	11	29.0	7	36.8	7	36.8	3	28	33.7
Farming	2	5.3			1	5.3	2	5	6.0
Business	4	10.5					1	5	6.0
Lost neighbors	2	5.3						2	2.4
Loss of tax base	1	2.6						1	1.2
Total persons	38		19		19		7	83	

to local nonfarm business, loss of tax base, and loss of neighbors.

White and Negro families differed in the indicated order in the importance of these changes. Among Negroes, effects on the church are most often mentioned (by 78 percent) with trading difficulties second (50 percent). A few persons mentioned general loss of population and harmful effects to elementary schools.⁽²⁸⁾ In contrast, loss of the high school was the most frequently mentioned change by white persons (88 percent), with churches second (81 percent), trading difficulties third (54 percent), and loss of population fourth (35 percent). The occupational differences are probably not significant, with race held constant.

(28) There is no Negro high school in the community. No Negro family reported children in high school.

Neighborhood and Community Changes

The preceding section has presented what local people think are the changes, especially harmful changes, produced by the reservoir purchase program in the neighborhoods of Harmontown. By means of the schedule, interviews with local leaders and use of data available in agency offices as much information as possible was gathered on these and other aspects of community life. These facts are presented here. Their implications, any evaluations, are postponed to the Conclusion.

Loss of Population. How many persons left Harmontown as a result of the dam? The study provides two clues to an answer. Each person interviewed was asked to name the families with whom his family "neighbored" at present. "Neighboring" was described, not as living close together necessarily, but as based on social visiting, borrowing, swapping work, and mutual aid. In addition, he was asked to name all the families with whom he neighbored **before** the purchase program got under way. The years 1935-36 were used as this reference point. With this information two maps were constructed showing every dwelling in the community and the name and race of the occupant in both years. At the time of the field work there were 132 residence structures in the community. Seventeen were vacant, and one house had two families living together. Thus 116 families were identified, 112 of whom were interviewed. Ninety-four families were living in the same houses both years. Of the 38 houses on which the 2 maps differed, 4 were vacant in 1935-36 but occupied in 1941, whereas 21 were vacant in 1941 but occupied in 1935-36. This leads to the conclusion that there were approximately 17 fewer families after the reservoir was filled than before its construction. The present families average 3.97 members each. At this rate, 17 families would be from 65 to 70 persons.

A further analysis was attempted. The names of the families on the two maps were compared. There were 30 families on the 1935-36 map who could not be found there in 1941. Thus it would appear that in the 5-year interval approximately 30 families left the community. What part of this movement was due to Government purchase of land and what to "normal" emigration is not known. All the movement was not forced by the purchase program, since 14 new families moved in during the same period. The net loss of 16 families agrees with the figures suggested above. Due to errors of reporting, suspected particularly with regard to Negroes, these figures represent underestimates. A net loss of 20 to 25 families—15 white and 5 or more Negro⁽²⁹⁾ seems a reasonable estimate. This would represent a total decrease of roughly 15 percent. Since the average family size in 1941 was 3.83 for white and 4.28 for Negro, the loss would be about 55 to 60 white persons and 30 to 35 Negroes, a total of 85 to 95 persons.

The effects of loss of population on the school, churches, and local business will be treated below. Here, however, the interest is in the less obvious effects on inter-personal relationships. In informal interviews, many persons mentioned "the loss of lifelong neighbors" with regret. The schedule contained data to show how many and what families had fewer neighbors in 1941 than in 1935-36. Table 26 contains this informa-

(29) Of the 80 families who left, 7 were Negro and 23 white. Of the 14 new families, 4 were Negro and 10 white.

tion. No Negro family reported fewer neighbors in 1941. One reported an increase. It is possible that some reporting error is involved here due to misunderstanding or reticence on the part of Negro interviewees. However, the net loss of families (as estimated above) was a smaller percent of Negro than of white families—12 to 20 percent. Forty-one (41) percent of the 70 white families reporting neighbors in both years said that they had fewer in 1941. Three reported more neighbors. Fifty-four (54) percent reported the same number. These data are based on recollection. Since the errors are probably those of understatement, it is reasonably assumed that slightly less than half of the white families in the community lost neighbors during the last 5 years, largely due to the purchase program. Table 27 indicates that two-thirds of the white families lost only one or two neighbor families. Forty-two percent lost only one. The largest losses reported were seven and eight, mentioned by one person each. This dislocation in the "neighboring" patterns⁽³⁰⁾ of the white neighborhoods was concentrated in the New Hope part of Perkins and in Free Springs. Several of the families, particularly in Free Springs, were

(30) No attempt has been made to treat any but the net loss of neighbors. From the data, however, it would be possible to see to what extent the loss of neighbors who moved was made up for by initiating such relationships with old residents and ones just moved into the community. Anyone wishing to make this analysis can secure the raw data by writing to the Station representative.

Table 26. Changes in number of neighbors per family (1936-41)

Race	Stayed same		Increased		Decreased		Total	
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
Negro	31	96.9	1	3.1			32	100.0
White	38	54.3	3	4.3	29	41.4	70	100.0
Total	69	67.7	4	3.9	29	28.4	102*	100.0

*Note: Ten families, new residents, did not report neighbors in 1936.

Table 27. Number of neighbors lost by white families

Number of neighbors lost	Families	
	No.	Pct.
1	12	41.5
2	7	24.2
3	3	10.3
4	3	10.3
5	2	6.9
6		.....
7	1	3.4
8	1	3.4
Total	29	100.0

conceded to have been community as well as neighborhood leaders. As one informant expressed it: When such families leave, "a community's morale deteriorates."

Loss of High School. One of the effects most resented by local citizens was loss of the Perkins High School. It and the trade facilities at Harmontown have been the nuclei of the community. In the school year of 1936-37, before the purchase program had much effect, the Perkins School had an average net enrollment of 196 pupils, of whom 54 were in high school.⁽³¹⁾ Of the six teachers, three taught high school subjects. One of the latter was a Smith-Hughes teacher of agriculture. In addition, a music teacher paid by the county came to the school at regular intervals. In 1937-38 the average net enrollment dropped to 168 pupils, 40 of whom were in the high school. Part of the loss was due to 12 high school students who in 1936-37 were transported from the Tallahatchie school district just south of the river. Thereafter, its high school pupils were sent to Oxford and its elementary pupils to College Hill. In 1938-39 the Perkins School had 132 pupils of whom 34 were in high school. The figures for the 1939-40 year were 103 and 27; and in 1940-41, 74 and 20.

During the summer of 1941 it was announced that beginning in 1941-42, Perkins would be a three-teacher elementary school. Plans had been made for transporting the high school pupils to Thyatira, 10 miles north of Perkins School and in an adjoining county. All students would be collected as at present and taken to Perkins. From there the high school students would be taken to Thyatira. All pupils, including first graders, would have to leave home a half hour sooner and return a half hour later.⁽³²⁾

Before the dam there were three one-teacher Negro schools in the community: one, Rush, in the northern part of Perkins; and two, Huston and Free Springs, in Free Springs. Huston was on the plantation of one of the prominent families of that neighborhood. The total average net enrollment of these three schools varied from 115 to 125 pupils between 1936 and 1939. After the latter year, Huston was combined with Free Springs. In 1939-40 the enrollment of Rush and Free Springs was 70; and in 1940-41, 85.⁽³³⁾ There was no indication, however, that the program of these schools was rendered any more inadequate than formerly. Former Huston pupils now have only slightly farther walking distances.

The Churches Lose Members and Support. The data on churches were gathered in interviews with leading or official members of each congregation. They represent the observations of the persons interviewed, colored by their opinions. Before the dam there were four white and one Negro congregations in the community. Most of the Negroes in Perkins neighborhood belonged to a church nearby in Panoia County. It was not studied.

Traditionally, the organized activities of these five churches were practically the same: weekly Sunday School, a monthly preaching service, and an annual revival meeting. All experienced the same effects. All reported declines in membership, ranging from about 60 per-

(31) Enrollment figures for the community's schools were secured from the county superintendent of education. Other data on Perkins School were given by its superintendent.

(32) These plans were put into effect, and in 1943 the school was still 3-teacher elementary.

(33) These figures should be considered approximate because of the county superintendent's doubt as to their accuracy.

cent (New Hope) to 30 percent (Oak Grove). This also meant loss of financial support. The New Hope congregation has suspended services in recent years except for the summer revival. There has been talk of consolidation with the other Baptist congregation at Harmontown, but there is opposition, particularly from members living on dirt roads along the reservoir and thus farthest from Harmontown. Some still hope that monthly preaching services can be resumed. It was reported that three of the churches were paying their part-time preachers a smaller salary. In two cases (one the Negro Church) this led to securing new preachers, stated by some to be inferior to the old. All reported that the financial burdens on remaining members had been increased. The loss of members by Oak Grove and Free Springs A.M.E. was partly due to their being cut off by the closing of the road from families living south of the river.

Dislocation of Roads and of Service Relationships. Harmontown is unique among the reservoir communities in the dislocation of its road system. Several, like it, found the upkeep of local dirt roads "relaxed" or abandoned. It, however, lost—through flooding—direct connection with Oxford, its county seat and main trade center. Study of this situation is nevertheless justified by the likelihood that at least one community will be so affected by any such flood control project.

Formerly, the trip from the general store to Oxford was 16 miles over an improved gravel road. The best of three routes in 1941 was 65 miles via Como and Batesville. Two shorter routes depend in part on circuitous country roads difficult in wet weather. At the time of the field work the WPA was improving a road from the northeast corner of the community to intersect the Oxford-Holly Springs highway. When completed this will bring Oxford within about 25 miles over a part gravel, part black-top road. The new road will make both Harmontown and Oxford more accessible to residents of the northeast part of the community than in the past. New Hope residents will have less access to Harmontown because of the deterioration of local dirt roads.

The schedule attempted to get a picture of the trade and other service relationships of the families both in 1941 and in 1935-36 before the program started. The hamlet, village, or town at which the family obtained each service was listed. If a service was obtained at more than one center, all were recorded in order of importance. The services studied were: retail trade, marketing of farm products, and other economic services; professional, personal, banking, and governmental services; recreational activities; and church and school attendance.

Three main types of situations were found. First, some services were obtained locally⁽³⁴⁾ and therefore little or no change had occurred as the result of the road situation. These are: church and school (except high school) activities; recreational activities⁽³⁵⁾—parties, entertainments, picnics, and "loafing"; men's haircuts, "at home" and by neighbors, as well as at Harmontown; cotton ginning at Harmontown (a little at Glennville); and grinding meal and feeds. Second, some services could be

(34) The terms "local" and "locally" refer to services obtained within Harmontown community, plus a few instances where an adjoining hamlet or small village was used. Tyro, Thyatira, and Glennville are the instances. Como, Sardis, Senatobia, and Holly Springs are classed as "other centers", meaning relatively complete service centers in addition to Oxford.

(35) Movies were the main "non-local" recreation. Six families had attended the movies in 1935-36, principally in Oxford. In 1941, two had ceased going, one still went to Oxford, and three had shifted to other centers.

obtained only at Oxford and therefore little change occurred despite the road closure. These are: governmental services—paying taxes, attending court, and visiting governmental agencies such as AAA, agricultural extension, relief and welfare; consulting a lawyer; and securing hospitalization. Most families who formerly went to Oxford for these services still do so, but in all probability less frequently.

Two other services showed little change, but do not fit the above categories. The women in 41 families patronized Oxford beauty parlors in 1935. In 1941, 33 still did so, whereas 8 had changed to other towns. In 54 families, women did their own hairdressing, or had it done by members of the family or neighbors. There was no change in this group. Farmers' marketing practices changed very little. Cotton is marketed in Como. Livestock is trucked to Memphis by a few large producers while the rest sell to local buyers. Produce is largely handled through local stores, and sold to local buyers. Thus the road to Oxford could have little effect on marketing practices.

In the case of nine services (groceries, work and Sunday clothes, light hardware, farm implements, furniture, banking, doctor, and medicine) there were important shifts. These were services which many persons formerly obtained in Oxford, but which can also be found in other towns, or locally. Oxford lost some of this patronage. Local merchants gained, but the other towns—especially Como—gained the most. Tables E—M, pages 46-50 in the Appendix show these changes in detail, classified by race. Formerly, from 30 to 60 percent of Harmontown residents sought these services in Oxford. Negroes were more localized in their trading habits than white families. After the road was closed, the percentages still going to Oxford ranged from 3 percent (groceries) to 29 percent (banking).

Local Business Declines. In the course of both formal and informal interviews, local merchants reported that they had lost business as a result of the reservoir and purchase program. Three reasons were given: loss of population, loss of some trade territory south of the river, and removal from cultivation of some of the community's best land. At Harmontown one firm operates the general store, main trade facility of the community, and the gin. This store's total volume of business declined about 40 percent between 1937 and 1941. In the same years the cotton ginned dropped from about 1,150 to 650 bales. What loss in profit this represents is not known. A smaller furnish store with incomplete stock had been operated primarily to service the "hands" of the owner and a few of his friends. Since there are now fewer sharecroppers in the area, it has been shifted to a cash business. The owner reports total volume of sales off about 40 percent during the "dam years." The other small store has been doing such a small business that it was difficult to assess the extent to which it was affected.

The filling station reports a 50 percent reduction in the amount of gas and oil sold. Several prominent families, heavy car users, left. Two other persons, one carrying the local mail route and one operating a truck, have moved and now buy their gas elsewhere. While the station suffered only a slight loss in its grocery, ice cream, and cold drink trade, its main income was from gas and oil. The barber shop which operates only on Saturdays was formerly open until 10 p. m. Now the customers are usually cared for in the afternoon. At the Perkins crossroads is a

small general store and grist mill, which moved to that location less than a year before the time of the field work. It had been in Free Springs at the junction of the roads from Harmontown and Perkins to form the main road to Oxford. When the road was closed, the store attempted to "follow the traffic." The owner reported he was doing about three-fourths of his pre-reservoir monthly gross business before he moved. Now, after about a year, business at the new location is getting back to this three-fourths level.

Summary

The construction of Sardis Dam has caused numerous changes in the lives of Harmontown residents. It is estimated that the community lost about 15 percent of its families—about 15 white and 5 to 10 Negro, 85 to 95 persons. Forty-one (41) percent of the white families report fewer neighbors in 1941 than before the dam. Approximately one-fourth of the families say their activities have been adversely affected, and three-fourths say their neighborhood has suffered harmful changes. A larger proportion of white farm owners and businessmen than of other groups spoke of such changes.

The filling of the reservoir increased the distance of community members from their county seat and main service center and cut off that part of Harmontown's service area which had been across the river. Those services which were obtained locally by most people and those which had to be sought in Oxford were little affected. In the case of nine important services, however, Oxford lost some of its former patronage to other towns, especially Como, and to community sources. Despite this gain at the expense of Oxford, Harmontown merchants report losses in volume of business ranging roughly from 30 percent to 50 percent.

Enrollment in the one white school fell to the point where the high school was closed, leaving a three-teacher elementary school. High school students are transported to an adjoining county. One Negro school was closed, leaving two one-teacher schools. The churches lost members and financial support. One congregation discontinued its services, but the others carry on with less money and, in two cases, with less satisfactory preachers.

V. Conclusion

By way of conclusion, an attempt will be made to evaluate, in the light of the study's findings, the principal criticisms made by local people of the reservoir purchase program; and to make, on the basis of the findings and the authors' experiences in the county, some suggestions which it is believed may help future projects of this kind avoid, minimize, or prepare for dislocations in family and community life.

Evaluation of Local Criticisms

Complaints of Displaced Families. In Section III a variety of reasons were advanced by those purchase families who felt themselves unfairly treated or worse off now than before. Here the principal ones are examined without regard to whether they were voiced violently by a few persons or were found to be more general.

"Displacement from the old home" was mentioned with great emotion. The study has shown that the majority who moved went to other, often adjacent, areas of the same county. A majority of all families are still

residents of the same community. There were, however, a few cases in which a disruption of family and neighborly sentimental ties was necessary. The effects endangered the future happiness and contentment of older persons particularly. These exceptional cases were sufficient to cause resentment among a wider circle of friends and former neighbors.

The widespread complaint that "the purchase price was too low" is hard to justify. Unquestionably, however, there were some individual farms whose superior fertility or improvements were not reflected in the purchase price. That the appraisers did a conscientious job is suggested by the fact that practically all the land was secured without resort to condemnation proceedings. In the few instances where the owner made condemnation necessary, the additional compensation awarded by the jury was reported to have been little more than the costs of the legal procedures. It is believed that much of the dissatisfaction regarding price was based on the smaller owners' reluctance to sell at any price. It is significant that the large operators, almost without exception, expressed entire satisfaction with the terms of sale.

Related to this price complaint was the reported "difficulty in finding other suitable land"—i. e., desirable fertility at a reasonable price. During the purchase negotiations it became generally apparent that some operators would be in the market for new land to replace that sold. While there is little evidence of speculative purchasing, the price level of farms in private ownership increased. The only other bottomland available in Lafayette County in any quantity was along the Yocona River, where another flood control program was being proposed. Prospective buyers were wary of another displacement. Most of the remaining available land was typically hilly, much of it overworked, gullied by erosion, and overpriced. Owners of the better farms were understandably reluctant to sell when they could see the difficulty of satisfactory relocation. When the quality of land bought and of land sold is taken into account, it appears that the average buying price of \$17.69 per acre was too high or the selling price of \$18.25 was too low. Interestingly enough, the charge of scarcity of good land was not directed at the Government. It was accepted as an inevitable result of the purchase program. Nor was there criticism of the fact that no agency gave any assistance to the farmers in relocating. Apparently neither of these was regarded as governmental responsibility.

Criticism of the "delayed payment" for land purchased by the Government seems justified. An average time of two to three years elapsed between signing the purchase agreement and final payment. Meanwhile, operators who had purchased other land, depending on proceeds of their sale to clear the debt, were forced to pay interest on their obligations while receiving none from the Government. The delay in clearing the title was recognized as necessary, but did little to abate the resentment.

It was charged that "some details of the purchase arrangement were not made clear." Original negotiations with the owners included two separate propositions: one setting a price per acre for an easement permitting the inclusion of their land for reservoir use, the other setting a price at which they were willing to give an option for selling outright. Some of the informants assert that the difference between the two propositions was not clearly explained, and they later found they had agreed to sell

at a lower price than they had intended. The chief complaint as to lack of clarity in the terms, however, regarded conflicting regulations respecting the cutting and selling of timber on the purchase tracts. Due either to contradictory regulations, changes made during the construction period, or failure in enforcement, the effects on the operators varied. Some cut and hauled away all the timber they wished; some were refused permission either to use or sell their timber, standing or already cut; while others were even required to reimburse the Government for that they had cut and sold. It is clear that the whole procedure relating to timber rights could have been greatly improved.

The "failure or refusal of the Government to buy the entire farm unit", although not serious in its effects, was another cause for resentment. Having established the 285-foot elevation as the maximum upper limits of the reservoir, the federal authorities were naturally reluctant to purchase more land than was needed. In many instances this contour line ran through a farm, cutting off the most desirable cropland and leaving in private ownership only the undesirable hill, pasture, or woodland. In some instances adjustments were made, but these were not always possible. Numerous cases still exist where the operator's unit comprises a small part of the original farm still in his ownership with the balance owned by the Government and leased back for operation on a yearly basis.

Many operators complained of "damage done to crops and fences by government employees." After the purchase agreements were signed and before construction of the dam, laborers were sent into the bottoms to clean the permanent reservoir of timber. It was charged that gates were left open and fences smashed, allowing stock to escape, and that growing crops were damaged by huge caterpillar tractors which operated without regard to roads or lanes. There is agreement that this situation prevailed quite generally. Most of the complainants stated it was largely because of the inability of the superintendents to oversee adequately a large and widely scattered labor force. Most aggravating was the fact that appeals to the workers themselves were generally useless, and the only means of redress lay in making a long trip to the construction headquarters. While the actual damage was slight, the seeming negligence of federal authorities was further cause for criticism.

Two further complaints concern disadvantages being suffered by operators after relocation. One is that they are "working poorer land" than before. To a considerable extent this is true, but it is also partly psychological. The land purchase for the reservoir included all the bottomland lying along the Tallahatchie River, which undoubtedly was some of the best and most productive land in the county. Because of the possibility of inundation, the tendency has been to increase the cultivation of less fertile land on higher elevations. Likewise, the land purchased by those who left the reservoir area is definitely of poorer quality than that which they sold. These facts support the contention of **some** operators that they are working poorer land than formerly, and are valid causes for complaint. On the other hand, only a small portion of the purchase area has been taken out of cultivation. Most of the bottomland is still being cultivated, although at an increased risk. It would appear that this complaint is justified in some cases, but the general consequences are not as serious as has been believed.

Another relates to the "insecurity of present leasing arrangements." Working under a 1-year lease from the Government, the operators assert that they are not justified in farming so as to maintain or increase the fertility of the soil, in making even necessary improvements to farm buildings, or in increasing their investment in farm equipment. While admitting that the rental price is favorable, they point out that the arrangement is temporary. The rental may be increased by the Government at its option. More important, it might decide not to rent the land at all. So far as is known, although the information from representatives of the War Department is entirely unofficial, there is no intention at present of changing the current leasing arrangements. It has been repeatedly emphasized that the primary purpose of the project is flood control and that except for emergencies the water level of the reservoir will not be raised higher than has been done. If the present prices and policies are maintained, it would appear that the lessees have little reason for serious complaint. However, the undesirability of short term leases is generally recognized.

It is admittedly difficult to evaluate criticisms arising from a program which affects such a large number of families, when both individual effects and personal reactions are so varied. Some complaints are the product of circumstances unique to one, or a few families. Others may represent an attempt to shift to the purchase program blame for financial losses due to poor management or other personal shortcomings. Or, the vague resentment of a person over the disruption of habits of thought and work may be crystallized by another's violently expressed opinion into a definite, although second-hand criticism. Behind this, however, has been found evidence of a few defects in the formulation and administration of the reservoir purchase program which future similar programs should take into account.

Community Effects. The chief complaints of Harmontown residents had to do with effects on school, church, and the road-trade situation. The "school" complaint is largely justified, as it relates to loss of the white high school. The combined elementary and high school served the entire community and was one of its main unifying factors. Its entertainments and programs focused the interests of adults as well as pupils, of non-patrons as well as parents. With Future Farmers of America, basketball, and other activities, it provided the only organized life for youth in an area where urban-ward migration is traditionally heavy. The extent to which the elementary program alone will be able to center the attention and interests of community members remains to be seen. Also, only time will tell whether increased transportation difficulties will cause more students to drop out of school after the eighth grade, as many persons fear. Because the high school pupils are to be transported into an adjoining county, all pupils must leave home earlier and return later. This is an aggravation of the often-stated grievance that little children are kept away from home and mother during most of the day, during much of which time they cannot be kept busy at school; and that older children are prevented from helping with farm and household chores.

The extent to which the present plight of Harmontown's "churches" is the result of the dam, is problematical. There is little doubt that they have "gone down" during the last 5 years—fewer members, less interest, less financial support, fewer recruits from the young adults. This, how-

ever, is the almost universal story of rural churches in the last 15 to 20 years. Informants in two of the local churches specifically stated that the trends of which they spoke antedated the beginning of this government program. The safest conclusion seems to be that dam-caused emigration and dislocation implemented and perhaps accelerated a trend already underway in the community.

"Loss of direct contact with its major service center" was the most disconcerting change thrust upon the community. For the services obtained there, it has meant going farther or shifting to other—usually inferior—sources of the service. This has been particularly hard on what might be called the middle class of community members. People with few resources have always traded locally, and thus were little affected. For a few well-to-do families, the longer trip to Oxford is more an irritation than a financial burden.

Two factors will change the road-trade situation from what it was at the time of the field work. First, the war and the rubber shortage will make the longer route to Oxford still more burdensome and will probably encourage more localized services than the study findings indicate. Second, completion of the new route via Abbeville will improve the situation. Upon payment of \$37,500 promised by the Federal Government to the county for "replacement of the facilities destroyed by the Sardis Dam in flooding the old Oxford-Sardis highway,"⁽³⁶⁾ the beat supervisor has promised to maintain this adequately as an all-weather road. Depending on the counter effects of these two factors, community unity may be lessened or promoted. If the community members come to depend more and more on local services, their level of living may be decreased, but integration could be the result of thus throwing the community back upon itself. Or, if the members of different parts of the community should divide their trade among several towns, then further community disruption would result. The present situation is loosening the socioeconomic ties between Harmontown and the county seat. And it contains the possibility, at least, of effecting permanent disruption of community unity in Harmontown.

Another complaint is that the "local economy" has been adversely affected. It has been shown that only a small part of the bottomland, main economic base of the community, has been removed from cultivation. To the extent that the former incomes of emigrated families are not being spent in the community and that inferior hill land has replaced some bottomland, less money is circulating locally. It is believed that the importance of these factors has been overemphasized. However, local merchants report they have lost from one-third to one-half of their gross business. If their estimates are correct and their profits have declined in proportion, the local economy has suffered some disruption. This has significance for church, school, and other activities, as well as for the stores and gin.

The "loss of neighbors" was also regretted by Harmontown's white residents. Quantitatively, slightly under half of the white families said they had one or more fewer neighbors in 1941 than 5 years previously. What this means qualitatively can only be inferred—and perhaps only

(36) The Oxford Eagle, Nov. 6, 1941, p. 1, section 1. See also page one of March 5, 1942 issue.

by those who have themselves experienced the security of personal, lasting relationships in a strong neighborhood or community. Habits of neighborly association built up through years of visiting, borrowing, swapping, pleasuring, and sorrowing together are not disrupted lightly. A bereavement follows the loss of neighbors as real, though not as intense, as that occasioned by loss of family members. Naturally such separation is hardest on older people whose attachments are firmer and whose opportunities for forming new associations are least.

These changes in family and community life have been received by Harmontown residents with concern and some irritation. It is likely that their feelings were the more intense because the community was previously integrated and its members appreciated the unifying bases of community life. To predict the success with which adjustments will eventually be made is impossible. Loss of the high school and certain aspects of the trade situation have potentialities for community decline and disruption. There is also the possibility that, having become more isolated and being unified in criticism of the "dam' dam", the community will maintain its identity and integration. In the summer of 1941, Harmontown still had considerable "community spirit."

Suggestions

Local residents appear to be justified in some of their criticisms of the Sardis Reservoir purchase program, its administration, and its effects. Therefore, it is pertinent to inquire whether there are ways by which some of these harmful effects could have been avoided, minimized, or prepared for. Were there, also, ways of preventing the misunderstandings which were expressed as poorly founded criticism? "Yes, to some extent," is the answer of the writers based on the findings of the study and their experiences in the area. The suggestions which follow are concerned with ways in which future purchase programs might escape some of the local criticism and misunderstanding.

It should be possible to devise some plan whereby owners could receive government payment for their land without the delay which occurred in the Sardis purchase program. Titles must be cleared, and the legal procedure is admittedly a slow process. Meanwhile, the former owner is embarrassed in meeting commitments made in the expectation of prompt payment. In private industry this situation is met by various types of title insurance which permit prompt payment of at least the major portion of the indebtedness. If governmental agencies could adopt similar procedures, the former owners would be aided in their negotiations for the purchase of new land and much resentment or resistance to current and proposed governmental purchase programs would be forestalled. If this cannot be done, the fact that payments will be delayed should be made clear during the purchase negotiations. In addition, serious thought should be given to the justice and possibility of paying interest to the sellers during the waiting period.

Complaints regarding misunderstandings over the terms of purchase and contradictions in the regulations as to timber rights seem to have been due in part to the inexperience or ineptness of the local men used as appraisers. The solution of this difficulty need involve no more than a definitely formulated policy, simple and understandable, and trained employees to carry it out. Possibly the whole purchase procedure would

run more smoothly and involve fewer repercussions if it were performed exclusively by federal employees, not residents of the local area.

In most of the complaints concerning destruction to fences and crops, it was seldom clear whether those guilty were employees of the Government or the construction company. In his wrath, all looked alike to the injured operator, and it was only natural that the blame should be charged to the Government. Again, the alleviation of this complaint would seem to be only a matter of more efficient administration and supervision, regardless of whether the Government or the contractor was at fault. Administrative officials should learn, if they have not already done so, that the temper and feeling of families involved in such a program are apt to be more sensitive than usual. If the agency does not wish to antagonize local people, it must sometimes bend backward in its efforts to avoid occasions for misunderstanding and grievance.

To search for ways to avoid complaints about the purchase price is probably fruitless. The Sardis purchase prices were in general based on a fair valuation. A few instances of low purchase prices, vociferously talked about, created the impression that none of the operators received a fair price—this despite the fact that few persons insisted a private sale would have brought more. The chief basis for the resentment of many former owners was the fact that they did not want to sell and therefore could not regard any price as satisfactory. To avoid this would necessitate the owner's giving unanimous consent to the project and its purposes. It is seldom, if ever, feasible to wait for this before starting a project.⁽³⁷⁾

The only feature of the renting arrangement of government owned land for agricultural use which is criticized is the 1-year lease. Its undesirability for the operator is apparent. It is not conducive to better farming practices and fosters a feeling of insecurity in the operator and his family. To extend the rental period would meet with almost unanimous approval. This should be done if it would not seriously hamper execution of the flood control project.

Some relocation of roads will be necessitated by most reservoir construction projects. Since the annual and maximum floodings can be estimated, it is possible to foresee the damage to the road system. Some of the damage will be permanent, other temporary. Some money was allocated for the replacement of road facilities damaged by Sardis Reservoir. It had not been paid to the county in 1941, 6 years after purchase of land began. Replacement of roads began after the reservoir began to form. It is suggested that county and state highway engineers should be informed of impending road changes as soon as the engineers of the construction agency are aware of them, that any funds given to the state and county for replacement be made available as far ahead of the filling of the reservoir as possible, and that substitute facilities be ready for use at the time old ones have to be abandoned. Thus, disruption of trade and service relationships would be minimized. In addition, final adjustments could begin at once and make-shift arrangements pending construction of roads and bridges be avoided.

The effects of loss of population on a community present more difficult

(37) See proposal for consultation machinery, page 43 following.

problems. If displacement of families could be prevented by the provision of alternative sources of income, the community structure would be less affected. This, however, is often impossible. Flood control dams, certainly, require few maintenance workers. The development of recreational facilities which might offer employment depends on local topography and climate and on location with regard to population centers. None of the north Mississippi dams seem to offer this opportunity.

All that can be done, then, is to prepare for and cushion the effect of emigration. This is mainly possible with regard to organized activities like school and church. It is a job of forecasting possible effects and developing adjustments tailored to the specific communities affected. It is suggested that the State Agricultural Extension Service is the logical agency to initiate these efforts. The proper specialists could cooperate with local extension agents and community leaders in encouraging the formation of local committees to channel local planning efforts and to work with such agencies as the county department of education, state denominational leaders, etc.

Several of the foregoing paragraphs indicate the desirability of some machinery for consultation between local residents and officials in charge of the purchasing and construction program. Misunderstandings which led to bitterness arose over the purchasing program. The government agency appears to have been oblivious to, and therefore unconcerned about, the effects of its acts on families and on community life. Many local people feel that whatever has been done was done to them without their consent and often without their prior knowledge. It would seem that much of the resentment, often bitter, of local people toward the project was directed not against **what** had been done, but **how** it had been done.

The formation of a project committee composed of responsible government officials in charge of the local program, of a few representatives of interested county agencies, and of local people seems desirable. It is suggested that such a committee be established prior to any work or purchase in the locality; that it be used as the medium for explaining the project, its purposes, its necessities (even if harsh) to the people of the counties affected; and that it be a means for bringing to the attention of government officials legitimate grievances and for planning to avoid or mitigate them. Such an arrangement would probably allow the government agency to do anything it needs to do—and leave a "good taste" in the mouths of the people, having entered into prior consultation with them. More important, it would allow the agency to avoid many actions of whose "irritation value" they would otherwise be unaware.

It was originally planned for this study to contain an analysis of the tax structure of the county as affected by the removal of land from the tax base. Although most of the government owned land has not been removed from the general economic base, the tax base has been reduced. What this will mean in less tax income, increased tax rates, and in decreased county services is not known. The question has been raised in Harmontown and in other parts of the county of the necessity or desirability of county consolidation. Both the annexation of the Harmontown area to adjoining counties and the consolidation of the entire county in case the Yocona Dam is constructed have been discussed. County leaders are aware of, and concerned about, these problems. They would wel-

come a thorough study of the financial bases of the county's government. Such a study should be made.

A final consideration grows out of an attempt—made by many local people—to weigh the benefits to downstream land and property against the dislocations of the reservoir area. A question often encountered was, "Why should we be penalized to help those rich Delta folks?" Perhaps more to the point was the belief that the main beneficiaries had been one or more real estate companies which had bought large acreages downstream and held them for the rise in price that came when the dam made them cultivable. Some asked whether the benefits were not overbalanced by the upstream damage plus the government expenditures.

The answer to this question is not within the scope of the study. However, several thoughtful persons made this interesting suggestion: that it would be desirable for the Federal Government to acquire simultaneously the reservoir area and the principal downstream lands to be made cultivable. Some of the latter could be exchanged with those families displaced upstream who wanted to settle in the Delta. The Government could sell the remainder so acquired to potential farmers at a fair price, using the profit to replace roads and other facilities destroyed, to make a payment in lieu of taxes to the counties in which land was permanently removed from the tax base, or to help defray construction costs. One of the important effects of this plan would be to eliminate completely the complaint that "the Government took all the best land and no other good land was available." If such procedure were deemed feasible and legal, it would go a long way in removing some of the misgivings which laymen feel toward such flood control projects.

Table A. Changes in number of livestock and workstock

Race and Tenure	Total operators	Milk cows			Beef cattle			Workstock		
		Before	Now	Change	Before	Now	Change	Before	Now	Change
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
TOTAL	157	520	447	—73	1,282	1,638	+356	684	675	— 9
TENURE:										
Owners	65	276	273	— 3	935	1,125	+190	487	474	—13
Renters	60	203	140	—63	329	493	+164	189	200	+11
Share-croppers	32	41	34	— 7	18	20	+ 2	8	1	— 7
RACE:										
White	91	377	338	—39	1,192	1,578	+386	554	562	+ 8
Negro	66	143	109	—34	90	60	— 30	130	113	—17

Table B. Use of money received from sale of land

Race and Tenure	Total (1) operators	Bought land	Built house	Bought other real estate	Made improvements on farm	Paid debts	Saved money	Bought equipment	Bought workstock	Bought car	All other
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
TOTAL	68	31	11	1	13	16	15	10	8	5	15
TENURE:											
Owners	55	30	10	1	12	11	10	9	3	5	13
Renters	12	1	1	—	1	5	5	1	5	—	1
Share-croppers	1	—	—	—	—	—	—	—	—	—	1
RACE:											
White	48	26	10	1	10	7	11	7	2	5	9
Negro	20	5	1	—	3	9	4	3	6	—	6

(1) Total number who sold land to Government.

Table C. Other changes in economic status

Race and Tenure	Total operators	Own tractor		Own car		Carry insurance		Have bank account		Public assistance (1)	
		Before	Now	Before	Now	Before	Now	Before	Now	Before	Now
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
TOTAL	157	14	15	60	72	99	99	47	58	10	11
TENURE:											
Owners	65	13	13	40	45	40	40	35	41	—	1
Renters	60	1	2	18	22	41	42	12	14	6	6
Share-croppers	32	—	—	2	5	18	17	—	3	4	4
RACE:											
White	91	14	14	51	59	56	57	43	48	3	6
Negro	66	—	1	9	13	43	42	4	10	7	5

(1) Direct relief, not including FSA or WPA.

Table D. Changes in participation in public affairs

Race and Tenure	Total operators	Daily paper		Hold office		Vote		Member cooperative	
		Now	Change	Now	Change	Now	Change	Now	Change
		No.	No.	No.	No.	No.	No.	No.	No.
TOTAL	157	36	-8	6	+2	85	-1	7	+2
TENURE:									
Owners	65	27	-3	3	+1	49	-1	4	+1
Renters	60	8	-4	3	+1	33		3	+1
Share-croppers	32	1	-1			3			
RACE:									
White	91	34	-7	6	+2	85	-1	7	+2
Negro	66	2	-1						

Table E. Trade changes by race, 1936-41: Groceries

Trade	Negro		White		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
At Oxford						
In 1936:.....	2	6.0	40	54.0	42	39.3
In 1941:						
No change.....			3	4.0	3	2.8
To local.....			15	20.3	15	14.0
To other town.....	2	6.0	22	29.7	24	22.5
Local trade						
In 1936:.....	23	69.7	27	36.5	50	46.7
In 1941:						
No change.....	22	66.7	24	32.5	46	43.0
Changed.....	1	3.0	3	4.0	4	3.7
Other town						
In 1936:.....	8	24.3	7	9.4	15	14.0
In 1941:						
No change.....	7	21.3	6	8.0	13	12.1
Changed.....	1	3.0	1	1.4	2	1.8
Total	33	100.0	74	100.0	107*	100.0

*Note: Five persons, two white and three Negro, were not living in the community in 1936. They are omitted from this and the following eight tables.

Table F. Trade changes by race, 1936-41: Work clothes

Trade	Negro		White		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
At Oxford						
In 1936:.....	6	18.2	38	52.1	44	41.5
In 1941:						
No change.....	1	3.0	9	12.3	10	9.4
To local.....			8	10.9	8	7.6
To other town.....	5	15.2	21	28.9	26	24.5
Local trade						
In 1936:.....	21	63.6	26	35.6	47	44.3
In 1941:						
No change.....	20	60.6	22	30.1	42	39.6
Changed.....	1	3.0	4	5.5	5	4.7
Other town						
In 1936:.....	6	18.2	9	12.3	15	14.2
In 1941:						
No change.....	5	15.2	8	10.9	13	12.3
Changed.....	1	3.0	1	1.4	2	1.9
Total	33	100.0	73*	100.0	106	100.0

*Note: One white person left question blank

Table G. Trade changes by race, 1936-41: Sunday clothes

Trade	Negro		White		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
At Oxford						
In 1936:.....	12	36.4	53	71.6	65	60.8
In 1941:						
No change.....	2	6.1	23	31.1	25	23.4
To local.....	1	3.0	6	8.1	7	6.5
To other town.....	9	27.3	24	32.4	33	30.8
Local trade						
In 1936:.....	14	42.4	13	17.6	27	25.2
In 1941:						
No change.....	13	39.4	10	13.5	23	21.5
Changed.....	1	3.0	3	4.1	4	3.7
Other town						
In 1936:.....	7	21.2	8	10.8	15	14.0
In 1941:						
No change.....	6	18.2	7	9.4	13	12.2
Changed.....	1	3.0	1	1.4	2	1.8
Total	33	100.0	74	100.0	107	100.0

Table H. Trade changes by race, 1936-41: Light hardware

Trade	Negro		White		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
At Oxford						
In 1936:.....	7	21.9	37	50.6	44	41.9
In 1941:						
No change.....			11	15.0	11	10.5
To local.....			9	12.3	9	8.6
To other town.....	7	21.9	17	23.3	24	22.8
Local trade						
In 1936:.....	19	59.4	26	35.6	45	42.9
In 1941:						
No change.....	18	56.3	24	32.8	42	40.0
Changed.....	1	3.1	2	2.8	3	2.9
Other town						
In 1936:.....	6	18.7	10	13.7	16	15.2
In 1941:						
No change.....	5	15.6	9	12.3	14	13.3
Changed.....	1	3.1	1	1.4	2	1.9
Total	32*	100.0	73*	100.0	105	100.0

*Note: One white person left question blank, and one Negro stated he did not buy light hardware.

Table I. Trade changes by race, 1936-41: Farm implements

Trade	Negro		White		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
At Oxford						
In 1936:.....	6	18.2	39	52.7	45	42.1
In 1941:						
No change.....			14	18.9	14	13.1
To local.....			7	9.5	7	6.5
To other town.....	6	18.2	18	24.3	24	22.5
Local trade						
In 1936:.....	6	18.2	13	17.5	19	17.8
In 1941:						
No change.....	6	18.2	12	16.1	18	16.8
Changed.....			1	1.4	1	1.0
Other town						
In 1936:.....	3	9.1	11	14.9	14	13.1
In 1941:						
No change.....	3	9.1	10	13.5	13	12.1
Changed.....			1	1.4	1	1.0
None	18	54.5	11	14.9	29	27.0
Total	33	100.0	74	100.0	107	100.0

Table J. Trade changes by race, 1936-41: Furniture

Trade	Negro		White		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
At Oxford						
In 1936:.....	7	21.2	39	52.7	46	43.0
In 1941:						
No change.....			14	18.9	14	13.1
To local.....	1	3.0	7	9.5	8	7.5
To other town.....	6	18.2	18	24.3	24	22.4
Local trade						
In 1936:.....	15	45.5	19	25.7	34	31.8
In 1941:						
No change.....	15	45.5	17	23.0	32	30.0
Changed.....			2	2.7	2	1.8
Other town						
In 1936:.....	7	21.2	12	16.3	19	17.8
In 1941:						
No change.....	7	21.2	11	14.9	18	16.8
Changed.....			1	1.4	1	1.0
None	4	12.1	4	5.3	8	7.4
Total	33	100.0	74	100.0	107	100.0

Table K. Trade changes by race, 1936-41: Banking

Trade	Negro		White		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
At Oxford						
In 1936:.....	10	30.0	41	56.2	51	48.1
In 1941:						
No change.....	6	18.2	25	34.2	31	29.2
To other town.....	4	12.1	16	22.0	20	18.9
Other town						
In 1936:.....	6	18.2	19	26.0	25	23.6
In 1941:						
No change.....	6	18.2	19	26.0	25	23.6
Changed.....						
None	17	51.5	13	17.8	30	28.3
Total	33	100.0	73*	100.0	106	100.0

*Note: One white person left question blank.

Table L. Trade changes by race, 1936-41: Physician

Trade	Negro		White		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
At Oxford						
In 1936:.....	2	6.0	32	43.2	34	31.8
In 1941:						
No change.....	1	3.0	15	20.3	16	15.0
To local.....	1	3.0	---	---	1	1.0
To other town.....	---	---	17	22.9	17	15.8
Local						
In 1936:.....	25	75.8	22	29.7	47	43.9
In 1941:						
No change.....	23	69.7	9	12.2	32	29.0
Changed.....	2	6.1	13(1)	17.5	15	14.0
Other town						
In 1936:.....	6	18.2	19	25.7	25	23.4
In 1941:						
No change.....	6	18.2	19	25.7	25	23.4
Changed.....	---	---	---	---	---	---
Total	33	100.0	73(2)	100.0	106	100.0

(1) Note: Most of this change due to the advancing age of the one physician resident in Harmontown.

(2) One white person reported his family did not consult a physician.

Table M. Trade changes by race, 1936-41: Medicine

Trade	Negro		White		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
At Oxford						
In 1936:.....	12	36.4	54	74.0	66	62.3
In 1941:						
No change.....	---	---	28	38.4	28	26.4
To local.....	---	---	7	9.6	7	6.6
To other town.....	12	36.4	19	26.0	31	29.3
Local trade						
In 1936:.....	15	45.4	11	15.0	26	24.5
In 1941:						
No change.....	14	42.4	8	10.9	22	20.8
Changed.....	1	3.0	3	4.1	4	3.7
Other town						
In 1936:.....	6	18.2	8	11.0	14	13.2
In 1941:						
No change.....	5	15.2	7	9.6	12	11.3
Changed.....	1	3.0	1	1.4	2	1.9
Total	33	100.0	73*	100.0	106	100.0

*Note: One white person left question blank.

COMMUNITY ADJUSTMENT SCHEDULE

Number _____ Neighborhood _____ Community _____

1. Has government purchase program caused any changes in the life of the family? (Circle proper answer.) Yes—Helped—Hurt—Both—No—Don't Know.

LIST WAYS

- a.
b.
c.
d.
e.

2. Has government purchase program caused any changes in the life of the neighborhood? (Circle proper answer.) Yes—Helped—Hurt—Both—No—Don't Know.

LIST WAYS

- a.
b.
c.
d.
e.
f.
g.

3. RACE: W—N—. 4. OCCUPATION _____ (_____) _____
(If farmer, give number of acres farmed)

5. SEX: M—F—. 6. AGE: (). 7. AGE OF MATE: (). 8. NUMBER IN FAMILY: ()

9. GRADE IN SCHOOL FINISHED: (). 10. GRADE IN SCHOOL MATE FINISHED: ().

11. How long has family lived at this location? _____ (Within a mile).

12. How long has family lived in this neighborhood? _____ (As defined by family).

13. Name of neighborhood moved from? _____

14. WHAT IS THE NAME OF THE NEIGHBORHOOD TO WHICH FAMILY BELONGS? This may or may not be the name of a nearby town, village, school, church, or creek. (If there is a real neighborhood which has no name, write **No Name**. If family belongs to no neighborhood, write **No Neighborhood**.) _____

Locate on map all families considered regular neighbors by family—because of visiting, work swapping, borrowing, help in time of trouble, etc. (Put **K** by those which are kin.)

15. BEFORE: Family No. _____ Neighbor(s) No. _____

16. NOW: Family No. _____ Neighbor(s) No. _____

17. What holds neighborhood together? List in order of importance.

- a. d.
b. e.
c. f.

18. With what other neighborhoods does family have contact?

NAME

KIND OF CONTACT

- a.
b.
c.
d.

19. Does family have county or other government business in Oxford? Yes? No?
List kinds:

	NOW				BEFORE			
	Main	2	3	4	Main	2	3	4
ORGANIZATIONS AND CLUBS:								
P. T. A.								
4-H								
F. F. A.								
Farm Bureau								
H. D. C.								
Missionary Society								
Church Youth								
Lodge								
Other								
Other								

21. List places mentioned in question 20 and give:

PLACE	DISTANCE FROM HOME	KIND OF ROAD	MEANS OF TRANSPORTATION
a. Neighborhood meetings			
b.			
c.			
d.			
e.			

22. A person "belongs" or "feels at home" in his neighborhood. Does family feel this way about any of the neighborhoods or places mentioned in questions 18 and 21? Answer No, or list places and give WHY.

General Comment

FAMILY DISPLACEMENT SCHEDULE

MISSISSIPPI STATE COLLEGE

Bureau of Agricultural Economics Cooperating

Race: W _____ N _____

Schedule No. _____

Name _____ P. O. Address _____

I. Residence of family head during last 10 years (1941-1931)

1	2	3	4	5	6	7
Community	County	State	Town or Farm	Dates (from 1941 back)	Tenure Status or Other Occupation	Chief Reason for Leaving
a)						
b)						
c)						
d)						
e)						
f)						
g)						
h)						
i)						
j)						

II. Comparison of status before and after displacement from Reservoir Area

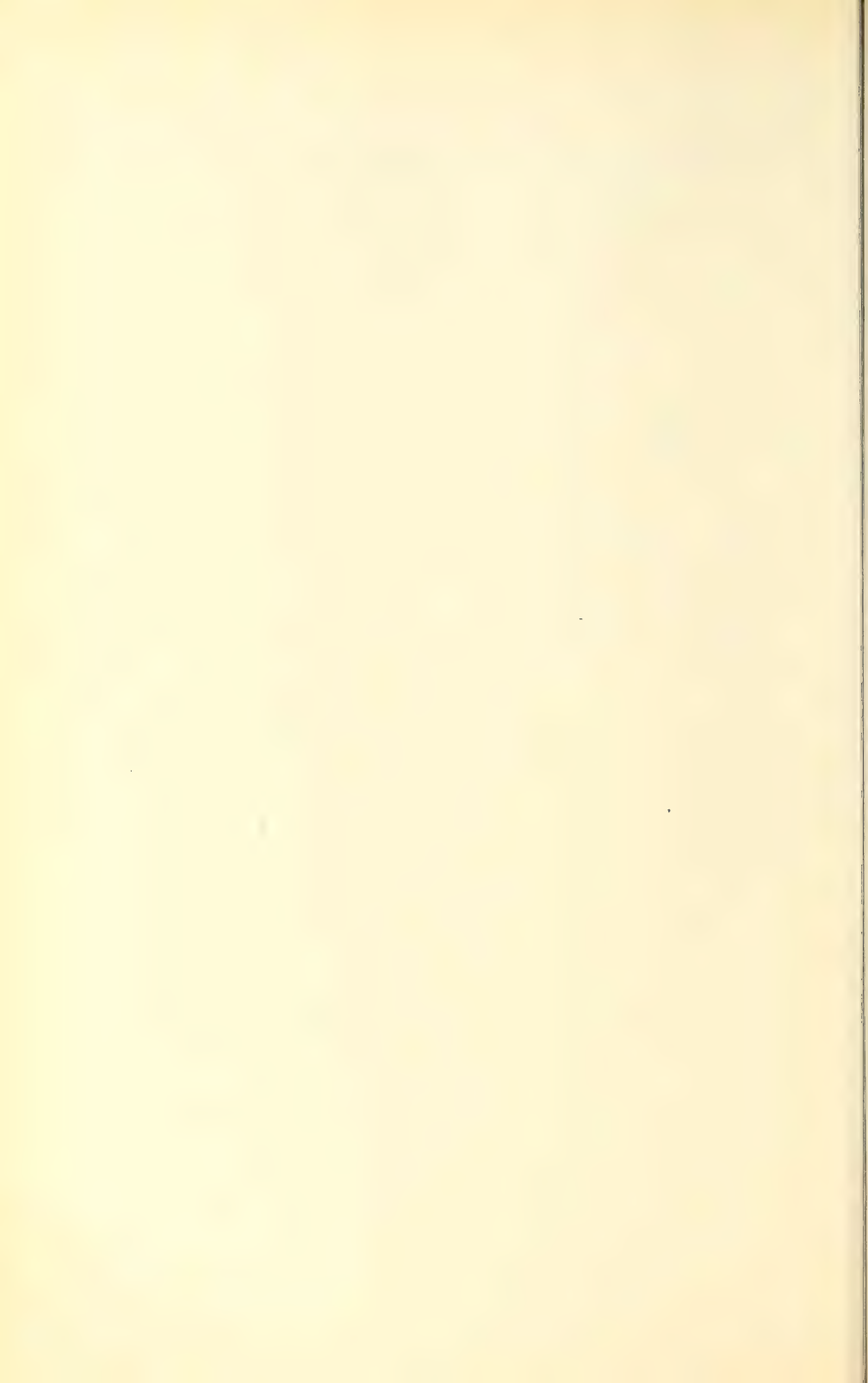
1. Economic	Before Moving	Now	2. Social	Before Moving	Now
a) Acres in farm			a) Miles to nearest neighbor		
b) Acres in crops			b) Miles to town		
c) Acres owned			c) Miles to store		
d) Acres rented			d) Miles to gin		
e) Acres share cropped			e) Miles to county seat		
f) Cotton allotment (AAA)			f) Miles to church		
g) Acres in cotton			g) Miles to grade school		
h) Average cotton yield			h) Miles to high school		
i) Acres in corn			i) Miles to doctor		
j) Average corn yield			j) Miles to all-weather road		
k) Acres other main crop			k) No. all organizations attended regularly		
l) Acres in pasture			l) Times attended church per month		
m) No. milk cows			m) Times attended farmers meetings per year		
n) No. beef cattle			n) Family visits per month		
o) No. workstock owned			o) Trips to town per month		
p) No. rooms in house			o) Movies seen per month		
q) Acres in home garden			q) Daily paper?		
r) Value farm equipment			r) Hold public office?		
s) Value farm buildings			s) Vote?		
t) Own tractor?			t) Member cooperative?		
u) Any insurance?			u) Days work exchanged per year		
v) Have bank account?					
w) Total debts					
x) Estimated net worth					
y) Public assistance					
z) Model car, if any					

FAMILY DISPLACEMENT SCHEDULE (Continued)**III. Composition of household**

1 Relation- ship to Head	2 Age	3 Highest School Grade Completed	4 Now in School? (Yes or No)	5 Birthplace		6 Check if not Living at Home
				County	State	
a) Head						
b)						
c)						
d)						
e)						
f)						
g)						
h)						
i)						
j)						

IV. Terms of land sale and purchase. Attitudes

- If you sold land in the purchase area to the Government: (a) Was land mortgaged?_____. (b) Amount of mortgage unpaid?_____. (c) Name of mortgage holder?_____. (d) Amount received for your equity in land?_____. (e) Do you consider this a fair price?_____. (f) What chief uses were made of money received? _____
- If you purchased land in new location: (a) What was price paid per acre?_____. (b) From whom purchased?_____. (c) Amount of down payment?_____. (d) Time allowed on balance?_____. (e) Interest rate?_____.
- (a) Are you renting land from Government?_____. (b) Number of acres of cropland?_____. Other land?_____. (c) Rent per acre for cropland?_____. Other land?_____.
- What was the most difficult problem you had to face in moving from the purchase area?_____
- What, if any, Government agencies assisted you in re-locating?_____
- Do you feel that you are now (a) better off, (b) about the same, or (c) worse off than before moving from the purchase area?_____. If "better" or "worse" explain why._____
- Do you feel that you were fairly treated by the Government in connection with your move from the purchase area?_____. If "No" explain._____
- General comments:



PLANTING COTTONWOOD on BOTTOMLANDS



By

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In Cooperation with
DELTA BRANCH EXPERIMENT STATION
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SUMMARY OF PLANTING RECOMMENDATIONS

- (1) Plant only on bottomland sites that are neither extremely dry in the late summer and fall, nor deeply flooded in the winter and spring. Sites so sandy and dry, or so low and often flooded, that they support little or no natural vegetation are not suitable for cottonwood.
- (2) Plant at 6-foot intervals in plowed furrows 10 feet apart. If the planting site is densely covered with undesirable vegetation, burn or disk the area before plowing.
- (3) Plant during the winter, when cottonwood is dormant, preferably in February.
- (4) Plant 1- or 2-year-old cottonwood seedlings collected from natural stands or grown in nurseries. Trim the roots to a length of 15 inches or less (to a point where the taproot is stiff enough to insert in the planting hole), and the tops to 10 inches. Make 20-inch cuttings from the tops thus cut off.
- (5) Plant seedlings with a rod that makes a hole $\frac{1}{2}$ -inch in diameter and 15 inches deep. Plant cuttings to the same depth with a rod that makes a hole $\frac{1}{4}$ -inch in diameter, or if the ground is soft simply push them in.
- (6) Release the trees from the competition of other vegetation at least once and preferably twice during their first growing season by hoeing away all vegetation within about 18 inches of each tree before it is overtopped.
- (7) Protect the trees from fire and grazing.

PLANTING COTTONWOOD ON BOTTOMLANDS

Eastern cottonwood (*Populus deltoides virginiana*) is one of the fastest-growing trees of commercial importance native to this country. The wood is in demand for a great variety of uses and usually brings good stumpage prices. Rapid growth and relatively high value make cottonwood a very desirable tree to grow in plantations.

There are two principal reasons for interest in cottonwood propagation in the Yazoo-Mississippi Delta and similar bottomland regions where cottonwood grows naturally:

(1) Mature cottonwood invariably is replaced by other, generally less valuable, and slower-growing species after logging. This means that cottonwood must be planted if its present and former sites are to be kept fully and highly productive.

(2) The heavily cut-over and burned-over areas most in need of planting are usually covered with such a dense, rank growth of weeds, shrubs, vines, and clumps of sprouts that only a very fast-growing species like cottonwood is likely to be successful in overcoming the severe competition. Since cottonwood does not occur naturally on such areas, except as occasional widely scattered trees, it can be obtained in adequate numbers only by planting.

Cottonwood is especially suitable for planting on farms because in addition to the commercial value of its wood it is useful for fuel, for shade, and in windbreaks. Ditch banks, fence rows, and other relatively small unproductive farm areas can be made productive and useful by planting cottonwood. There may even be an advantage in planting small accessible areas because of the more intensive care and management that can be applied.

Relatively few attempts have been made in the Yazoo-Mississippi Delta and similar bottomland regions to plant cottonwood on forest land. There is, therefore, only a meager background of either experimental or practical experience. Beginning in 1940, however, research in cottonwood propagation has been conducted at Stoneville, Mississippi, as part of a cooperative Farm Forestry Research Project by the Southern Forest Experiment Station, Forest Service, U. S. Department of Agriculture, and the Delta Experiment Station. This bulletin is based largely on the results to date of this investigation. Much more work remains to be done before many of the recommendations made here can be adequately checked, and the recommendations must accordingly be considered subject to later modification. It will be a relatively long time before all of the problems of cottonwood propagation are finally solved, however, and in the meanwhile it seems desirable to release the information obtained to date.

RANGE

Eastern cottonwood is found throughout the eastern half of the United States, and has been planted extensively in shelterbelts in the Plains States. It grows naturally on stream banks and other moist

sites, and makes its best growth in the lower Mississippi River valley where extensive pure stands are found on the islands and batture¹ lands of the Mississippi River. On such lands it is commonly found in mixture with willow in young stands, but the faster-growing cottonwood gradually assumes a dominant position and large cottonwood is generally found in pure stands. It also occurs as scattered individuals or in small groups in mixture with other hardwoods throughout the bottomlands.

USES

The wood is light in weight and color, comparatively uniform in texture, and generally straight-grained. These characteristics make it very desirable for industrial lumber, veneer, and excelsior. Most of the lumber is used in boxes and crates, for which it is especially well suited because of its light weight, lack of odor, ability to take nails without splitting, and good color for stenciling. Cottonwood yields an unusually high percentage of clear wide boards and is therefore much used as core stock in large panels and as wagon box boards. Cottonwood veneer is used principally in containers, but is used also in furniture and other products. Cottonwood is also suitable for pulping, and is used in the manufacture of paper and fiber board.

Annual production of cottonwood lumber in the South from 1931 to 1940 averaged about 60 million board feet, and most of this came from the Delta regions of Mississippi, Arkansas, and Louisiana. At the present time production is much greater because of demand created by the war. In 1939 cottonwood ranked fifth nationally among veneer woods in the amount consumed.

RATE OF GROWTH

Cottonwood is a relatively short-lived tree but grows so rapidly that it soon reaches a large size. In natural stands and plantations² on the better sites, cottonwood commonly increases $\frac{2}{3}$ to 1 inch in diameter and 5 feet in height annually up to 10 or 15 years of age, and grows at only a slightly slower rate up to 30 or 35 years. Well-stocked natural stands in the Mississippi Valley have been found to contain trees averaging 20 inches in diameter at breast height and 120 feet high when 35 years old. The growth rate starts to decrease sharply at about this age, however, so it is probably best to harvest the entire stand at about 35 years of age and replant. In well-stocked stands, cottonwood prunes itself very well, and produces a long, straight trunk that is generally clear of limbs for at least 50 feet when mature.

Fully stocked natural stands on good sites have been estimated to yield about 6 cords of pulpwood at 5 years, 24 cords at 10 years, and 50 cords at 15 years. The volume in board feet per acre, Doyle rule,

¹The unprotected area between the Mississippi River and its levees is known locally as batture or batture land.

²As used here and elsewhere in this bulletin, "plantation" refers merely to a group of planted trees, regardless of the area involved.

in similar stands has been estimated at 5,700 at 20 years, 10,700 at 25 years; 19,200 at 30 years; and 27,500 at 35 years. These impressive figures on yield show clearly the tremendous growth rate of cottonwood. Most natural stands, especially over large areas, are not fully stocked and therefore do not attain these yields. If survival is high, however, cottonwood planted at uniform spacing can be expected to equal the yield of fully stocked natural stands. Yields from well-stocked plantations that are thinned periodically will exceed the yields of unthinned natural stands on similar sites.

NATURAL REPRODUCTION

It is usually impossible to obtain adequate natural reproduction of cottonwood on most land from which mature cottonwood is cut. Cottonwood will seed itself only on bare soil that is saturated, but not covered, with water for long periods during seedfall. The site must remain moist and practically free of vegetation throughout the seedling's first year if good growth is to be obtained. The abundant moisture needed for seedling establishment cannot readily be supplied artificially on forest land in the Delta except perhaps on a small scale by irrigation. Receding flood waters or abundant rainfall are effective only if they keep the soil saturated for long periods during seedfall, and this condition is seldom obtained and obviously cannot be depended upon at any given time and place. Since the moisture requirements for natural reproduction are so exacting, cottonwood must be planted to insure its establishment.

PLANTING

Sites

Cottonwood makes its best growth on moist but well-drained sandy loam or silty soils in the batture, but growth is also very good on heavy clay soils along ditches, and on the gentle slopes bordering swamps and sloughs. Plantations made on such sites are most likely to be successful. Heavy clay "buckshot" soils that crack open as they dry out in the late summer and fall are unfavorable to the establishment of cottonwood, but it is thought that successful plantings may be made here with proper intensive care. Coarse sandy ridges or former sand bars, common in the batture, are unsuited to cottonwood. These sites are so sterile and dry that vegetation is sparse or lacking, and cottonwood plantings are almost certain to fail. A shallow water table or an unusually wet year may sometimes make cottonwood plantations possible on these sites, but they are factors that cannot be relied on. Low swampy sites, sloughs, or drains where planted trees may frequently be submerged for long periods are entirely unsuitable for cottonwood. Most bottomland sites that are neither extremely dry in the late summer and fall, nor deeply flooded in the winter and spring, seem satisfactory for cottonwood.

Site Preparation Before Planting

Preparing or treating the planting site before planting is necessary (1) if the site is so covered by vegetation that both planting and sub-

sequent release or cultivation of the planted stock are very difficult or impossible unless the site is at least partially cleared, or (2) if the site is so poor for cottonwood that planting in furrows and rather intensive subsequent cultivation are desirable. Burning is probably the cheapest effective method for clearing a planting site, but fire is a tool that must always be used with great care. Burning should be done only on sites where there are no trees (or only a negligible number) worth keeping, and where the fire can be kept from spreading to areas not scheduled for planting. In bottomlands, burning is usually practicable only in the fall. A heavy or clean burn is needed.

If for any reason burning cannot be done, a heavy disk plow pulled by a crawler-type tractor is suitable for preparing sites where there are not many large trees, stumps, or logs. Poor sites that will be cultivated rather intensively should be disked before planting in order to facilitate the later cultivation.

It is highly desirable but usually not essential to plow furrows in which to plant. A middle-buster plow is most suitable for this purpose. Furrows make planting easier and provide better alignment of rows, but their most useful function is to facilitate finding the planted trees when they need release from the competition of the surrounding vegetation. By cutting shallow roots and turning over several inches of soil, furrowing also retards the growth of competing vegetation and thereby both postpones the first release and makes a second release less likely to be needed. Finally, there is some evidence, especially on the drier sites, that trees planted in furrows survive and grow somewhat better than trees not planted in furrows. Good sites that are relatively free of vegetation, perhaps because of recent logging or recent abandonment from agricultural use, are least in need of plowed furrows.

Spacing

Until comprehensive information on the growth of cottonwood at different spacings can be obtained, the best spacing for plantations is debatable. Growth, however, is affected not merely by original spacing but also by the actual survival, which can only be estimated and may well be affected by various unpredictable factors. For this reason, the best spacing can never be rigidly defined but is actually rather flexible.

It is tentatively recommended that cottonwood be planted 6 feet apart in rows 10 feet apart. This spacing, providing for 726 trees per acre, seems most desirable from several standpoints. Because of the rapid growth and heavy natural thinning characteristic of cottonwood stands, 726 planted trees per acre are enough for a reasonably satisfactory stand even if the survival should be as low as 40 or 50 percent. Spacings closer than 6 by 10 feet seem likely to be unnecessarily close, and wider spacings may often result in understocked stands of very limby trees. For the same number of trees per acre, planting and subsequent release or cultivation are cheaper with rectangular spacing than with square spacing. If plowed furrows are

used, fewer furrows are needed. When rows are at least 10 feet apart, trucks may be driven between them to pick up material cut in thinnings.

It is thought that a 6- by 10-foot spacing is equally suitable for the production of sawlogs and pulpwood. Regardless of the product cut, however, frequent thinnings—starting at an early age—will be needed in order to obtain maximum yields and profit. The better the survival, the earlier the thinnings should be started and the better will be the ultimate total returns.

Planting Stock

Best results are obtained by using 1- or 2-year-old seedlings and cuttings taken from the tops of such seedlings. Cuttings taken from the crowns of older trees are not recommended; failures are too frequent to justify their use. Cuttings taken from 1- or 2-year-old sprout growth, especially from very young stock such as can be produced in a nursery, may also be suitable for planting, but have not yet been thoroughly tested. One-year-old seedlings or wildings about 2 to 5 feet tall from batture lands, borrow pits, or ditches are ideal. Nursery-grown seedlings of the same size are equally good. Seedlings are collected simply by pulling them out of the ground.

Before planting, the tops of seedlings should be cut back to a length of about 10 inches (see figure 1). Tall, uncut seedlings do not survive as well as those cut back, although 10 inches is a somewhat arbitrary choice. Seedlings cut back to 4 inches may survive and grow as well as those cut back to 10 inches, but they need to be released earlier and are more difficult to find. If planted in furrows some loss may also occur as a result of silting, which may cover the short tops with several inches of soil. The only disadvantage of lengths from 10 to 20 inches is that less top material can be utilized as cuttings. Lengths greater than 20 inches usually do not survive as well as shorter lengths and should be used only on low sites likely to be flooded deeply for a long period. Complete inundation of the trees for more than about a week during the growing season delays growth and may be fatal. Twenty-inch cuttings should be made from the pruned-off tops of seedlings; they survive and grow as well as the parent seedlings, and their use doubles or triples the amount of planting stock obtainable from a given number of seedlings.

Since cuttings from the top of a seedling are fully as satisfactory as the entire seedling or any part that includes the roots, wilding stock may be collected simply by taking cuttings in the field without pulling the seedlings. It is cheaper to collect in this way when wildings are plentiful or when the ground is hard and it is difficult to pull or lift the plants without digging. Cuttings also have the advantages of being easier to handle, prepare, and plant than rooted stock. When wilding stock is scarce, however, or when the plants are easily pulled, it is generally best to use both rooted stock and cuttings.

If seedlings are planted with a rod, as recommended below, the

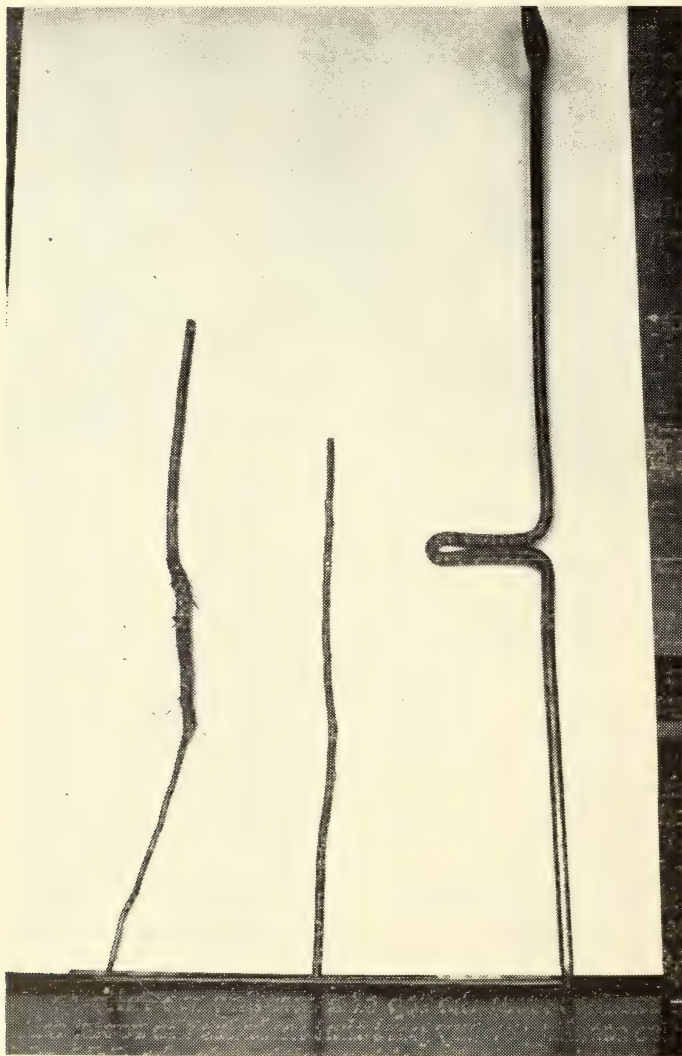


Figure 1. Cottonwood planting stock and planting rod. From left to right: 1-year-old wildling with top pruned to 10 inches and roots pruned to 15 inches; 20-inch cutting made from pruned-off top; and planting rod made for planting 15 inches deep.

taproots must be cut back to 15 inches or less, to a point where the taproot is stiff enough to insert in the planting hole, and the larger side roots must be pruned just enough to permit this insertion. Seedling roots must be kept moist at all times to prevent harmful drying. Less care is required for cuttings, but they should not be exposed to the sun or wind. Planting stock may be safely kept before planting by placing the roots of seedlings and the butt ends of cuttings in water (e.g., in ditches or stump holes), or by heeling-in in moist soil. Stock may be safely stored for long periods in moist cold storage at about 40° F., but this is recommended only if planting must be delayed until growth starts. It is best to place seedlings in cold storage in an uncut condition, cutting them back just before planting.

Method of Planting

A planting rod is recommended as the most suitable tool for planting because it is easy and cheap to make, quickest to use, and results in satisfactory survival. The rod should be made of rod iron, bent at 15 inches from one end to form a step that will be needed in hard ground. The upper end should be shaped to form a convenient handle, either T- or D-shaped, and the lower end should be pointed to aid penetration (see figure 1). The diameter of the rod should correspond to the diameter of the stock to be planted. A ½-inch rod is best for most seedlings and for most cuttings taken from sprouts, but a ¼-inch rod is best for most cuttings made from the tops of seedlings. It is important to get good contact in the hole between the planted tree and the soil, especially at the bottom of the hole. Cuttings should simply be pushed into the ground to the desired depth if the soil is soft enough.

Before planting with the rod, seedlings should be root-pruned sufficiently to allow insertion in the hole. The root length should not exceed the depth permitted by the step on the rod, preferably about 15 inches. If roots are shorter than this limit, a portion of the stem should be inserted in the hole to make up the deficiency. It is important to get good depth in planting: 10 inches should be the minimum on moist sites and 15 inches the minimum on dry sites.

Cottonwood seedlings may also be planted with the wedge-shaped bar commonly used for pine, or with a mattock, but these tools are much slower to use than a rod, especially in wet clay soils, and their use has not resulted in appreciably better survival or growth.

Planting is done most efficiently by a man who carries his stock either in a basket, tray, or cloth sack slit to permit hanging from the shoulder. Provision should be made for keeping the roots moist at all times.

The boundaries of a planting area or the ends of rows should be conspicuously marked to facilitate finding the trees when cultivation is needed. Stakes or bright cloths make good markers. Trees usually will be hard to find if they are not planted in plowed furrows, but it does not seem practicable to mark each tree separately.

Time of Planting

Cottonwood may be planted at any time during the dormant season, i.e., after the leaves have fallen in the autumn and before the buds open in the spring. In the Yazoo-Mississippi Delta, this season usually extends from late November or early December until early to late March. February is probably the best single month since it does not seem desirable to leave the dormant stock exposed to drying winds, floods in swamps, rabbits, or other injurious agencies for a long period. The ground is also likely to be most favorable for planting in this month. On the higher lands the soil is likely to be wetter in February than in the two preceding months. On the lower lands, if there is standing water, stock planted in February will not have long to remain in the water before growth starts, and the stock can be set with its tops above water with more assurance of retaining this position.

Cultivation

Cultivation or release of the planted trees from competing vegetation during the first year is essential. This is most simply done by cutting away all vegetation within a radius of about 18 inches from the tree with an ordinary cotton-chopping hoe. The time and frequency of release should be governed by the kind and density of competing vegetation, and its rate of growth compared with that of the cottonwood. In general, it is desirable to make a first release in early May, or not later than early June, and a second release late in June or in July. Each release should be made before the cottonwood is overtopped. When released early, the trees are more readily found and are likely to get off to a better start in growth. A disadvantage of early release is that it increases the need for a second release. Although one release may suffice if it is skillfully timed, it is usually better to make two releases. Plowed furrows will delay for several weeks the need for a first release, and thereby decrease the need for a second release. One man with a hoe can release from $\frac{1}{2}$ to 1 acre per day, depending upon the spacing, the amount of vegetation, and the ease with which the trees are found. Release is most rapid in plowed furrows. It will usually be unnecessary to make any release in the second year, although if vines are abundant it may be desirable to cut them to prevent serious damage to the form of the trees.

More intensive and probably more beneficial cultivation can be done with either machine or horse-drawn equipment. Only well-cleared sites or recently abandoned farm lands are suitable for such intensive cultivation, however, and they must be thoroughly disked or otherwise prepared for cultivation before planting. Even with machine cultivation, supplementary hand hoeing will be necessary in the first stages. Check plowing will minimize the need for supplementary hoeing, but perfect alignment of the trees is required for such work.

In a few instances, corn has been grown between rows of cottonwood and both plants have been intensively cultivated until the corn

was harvested. The cost of establishing a cottonwood plantation is greatly reduced by the returns obtained from the corn, and the cottonwood benefits greatly from the intensive cultivation that is required. This practice seems especially applicable to sites where cottonwood will not survive or grow well without intensive cultivation, but needs further testing before definite recommendations can be made. A site that is sufficiently cleared and cultivated, and permanently suitable for corn or some other agricultural crop, ordinarily should be devoted entirely to agricultural use and not planted with cottonwood. On the other hand, a site that is marginal or submarginal for agricultural use might well produce a good enough single crop of corn or cotton in a favorable year to defray most of the cost of establishing cottonwood.

Survival

Survival at the beginning of the second growing season in the field will probably range from about 30 to 90 percent, and the distribution of survivors is likely to be patchy or groupwise. Present experience is too limited to permit more specific estimates of survival for given sites or other conditions. It is also impossible at the present time to define the minimum survival that should be considered satisfactory. Whether or not a given plantation can be considered satisfactory, and whether or not it should be replanted or filled in, will depend on the suitability of the site, the normality of rainfall during the first growing season, the apparent causes of mortality, the distribution of surviving trees, the occurrence of desirable volunteer tree growth, and whether the principal objective is sawlogs or pulpwood. On a favorable site, with well-distributed survival, replanting the blanks will usually be inadvisable because of the likelihood that the replants will soon be suppressed. On medium or poor sites, however, or on good sites where survival is groupwise, it may well be advisable to fill in the blanks in the second year unless there is a good stand of desirable volunteer tree growth. Other things being equal, it is better to replant when low survival seems to be due to abnormal or subnormal rainfall than when low survival occurs with normal rainfall. Filling in blanks and later releasing the trees will be expensive, however, and the probable advantages should be carefully weighed against the estimated costs before replanting is undertaken.

In view of the present meager background of experience in planting cottonwood, it is best to begin planting on a relatively small scale on each different site or location. On sites where good results are obtained, the scale of planting can then be increased with some assurance of success. On sites where poor results are obtained, it is best to continue planting only on a small scale, modifying the technique as seems desirable, until either good results are obtained or it is decided that it is impossible to establish a good plantation.

GROWING NURSERY STOCK

Cottonwood planting stock may be successfully raised in a nursery, frequently for less than the cost of collecting wildings. A nursery also

has the advantage of providing a dependable source of supply. Accessible supplies of wildings are not always readily available when needed for planting. High water, not uncommon during the planting season, may make wilding collection extremely difficult or impossible. Wildings may also be scarce because of unfavorable conditions for establishment the previous spring.

Seed Collection

Cottonwood seed is usually mature early in May in the central portion of the Yazoo-Mississippi Delta. Seedfall generally occurs from about the first of May until July or August, with dissemination at its peak in late May. Seed may be safely collected after the first of May, and frequently collection is possible from a few late-maturing trees in June. A good rule to follow is to collect when the first pods begin to open; if collection is delayed too long, lower yields of seed per tree will be obtained.

The best seed-bearers are large, open-grown trees. Usually, little seed can be collected from trees less than 10 inches in diameter at breast height or less than 10 years old. Seed is borne only by female trees, and abundant crops are produced every year. Female trees bear yellow flowers, and male trees bear red flowers.

The green pods or capsules are most easily gathered from felled trees, but can be collected from standing trees by climbing or using a ladder. Logging operations are convenient places to collect seed. A large tree may yield over a bushel of seed pods, from which several pounds of seed can be extracted. A pound of seed, clean enough for sowing, contains about one-half million seeds.

If stored in bulk following collection, the pods will heat; they should therefore be spread out in thin layers to precure or dry at ordinary room temperature for 2 or 3 days before extracting the seed. Most of the pods will still be closed, but sufficiently dry to be easily opened by hand or mechanical maceration. The pods may be macerated immediately after picking, but seed extraction is more difficult at this time and the seed yield may be less. The pods may be air-dried for a week or more with little or no loss in seed viability, and even longer storage periods are possible in moist, cold storage at about 40° F.

Maceration releases the seed by crushing the pods, and to some extent loosens the seed from the cottony matrix which surrounds it. It is accomplished simply by rubbing or crushing the pods against a coarse screen by hand. If large quantities are to be handled, grain hammer-mills or other mechanical macerators can be used with greater efficiency. The seed is then separated from the "cotton" by rubbing over a screen wire of small mesh, such as a window screen. Only about 20 percent of the seed actually handled is readily extractable; beyond this point, further rubbing yields so little seed that it is probably unprofitable.

The seed should be sown immediately after extraction. Its viability is greatly reduced in a few days by dry, open storage, although it may be safely kept for a week or more in moist, cold storage.

Seed Sowing

The best nursery soil is a fertile sandy loam. Seedbeds 4 feet wide with shallow alleys or pathways 1 foot wide between beds are suitable. The beds are formed by breaking out the alley with a middle-buster, then leveling off the bed surface with either a rake or a drag.

The seed is sown on the surface of the bed by hand, either broadcast or in drills, 6 inches or more apart, and should not be covered. Broadcast beds are more easily sown and will produce more plantable trees per unit area owing to the better distribution of seed, but drilled beds are more easily weeded and may be cultivated. Cottonwood seed is so small that care is needed to obtain a uniform distribution of seed on the bed. Mixing the seed with a dry sandy soil will help. It is also desirable from this standpoint to sow unclean seed that is obtained by extraction through a large-mesh wire screen that allows portions of seed pods to fall through along with the seed.

Fresh seed is highly viable, with 80 to 90 percent germination. Actual tree percentage will of course be much lower, for the young seedlings are so fragile that the slightest adversity in field conditions causes considerable loss. It is therefore wise to sow heavily to insure a fully stocked stand, and thin later to the desired density if the stand is overstocked. A good stand can generally be produced from 1 ounce of clean seed per 100 square feet of seedbed, or about 300 seeds per square foot. If drill-sown, 100 seeds per linear foot are adequate if well distributed.

Constant, ample moisture is required for germination and initial establishment of the seedlings. If an overhead sprinkling system is available, the beds should be kept continually moist by frequent sprinkling. Equally good results may be obtained by irrigation, in which case the beds are first thoroughly soaked by flooding and then drained just enough to expose the surface on which the seeds are sown, preferably broadcast. Sufficient water is used to keep the alleys full, thus maintaining a saturated bed. This method is especially suitable for a small nursery, but requires a level site. The young seedlings should not be submerged, for development is then checked and some mortality will occur, especially on hot, sunny days.

The surface of the bed must be kept continually moist for at least 3 days after sowing. Germination occurs within 12 to 24 hours after sowing, when the radicle, surrounded by a tuft of fine white hairs, emerges from the embryo. With the hairs acting as an anchor, the cotyledons rise and open. This is followed by elongation of the root, which penetrates to a depth of about 1 inch by the fifth day. The seedling develops very slowly at first, but after about 3 weeks growth accelerates steadily and rapidly.

Shades or screens help to conserve and maintain uniform surface moisture, but are needed only if sufficient moisture cannot otherwise

be maintained. Half shade provided by a screen made of laths stapled with wire is suitable.

If the beds are overstocked, the seedlings should be thinned when about 4 weeks old to approximately 20 trees per square foot. Subsequent cultural care during the growing season is the same as for most other tree species. The beds will need weeding several times, especially when the seedlings are small. This involves hand-picking if the seed were broadcast, but may be done largely with a hoe if the seed were drill-sown. The trees should be watered generously during the summer, either by overhead sprinkling or by irrigation.

PROTECTION

Cottonwood plantations must be completely protected from both fire and grazing.

Small trees are very easily killed by fire, even light fires. Large trees may survive a light fire but are badly scarred by fire and soon develop serious butt rot that greatly reduces the amount of merchantable wood. Plantations should be protected from fire by a cleared and plowed fire-line about 15 feet wide.

Cattle and other livestock seriously damage small trees by browsing and trampling, especially if other forage is scarce. This not only directly kills many trees but also prevents the survivors from making the vigorous early growth that is essential for a successful plantation. If accessible to any livestock, plantations should be fenced before planting.

Rabbits gnaw the bark of small trees in winter, sometimes completely girdling them. Where rabbits are numerous, much damage may be done. In most cases of girdling, however, the tree sprouts again and there is little direct mortality. Spraying or painting the trees with rabbit repellent may give some measure of control, although generally it is not worth the added expense. An effective repellent is made by stirring 5 pounds of liquid asphalt paint into 3-1/3 quarts of water, adding 3-1/3 pounds of copper carbonate, and enough water to make up 4 gallons.

Poplar canker (*Cytospora* sp.) often kills unhealthy or weakened young trees, especially on adverse sites where growth is relatively poor. Mortality due to this canker seems to occur mostly in the late fall and early winter, when the trees often lack adequate moisture. The inner bark on the main stem is attacked and killed first, and dead or dying trees may have healthy looking tops for a month or more. The canker is very common, and lives on dead wood when injured or weakened live tissue is not available. The only remedy seems to be to promote vigorous growth in the first year by adequate release or cultivation.

Poplar leaf-beetles and caterpillars cause partial and sometimes complete defoliation of small trees both in plantations and in nursery beds. The insects may be found during most of the growing season.

but are likely to be most numerous and damaging in late summer. The damage usually is not serious, however, since even complete defoliation results only in slightly reduced growth. Control measures are not needed in plantations, but may sometimes be desirable in nurseries. Spraying with arsenate of lead is effective where control is needed.

Aphids or plant lice, cultivated by ants, often cause slight damage by retarding the growth of infested trees. Most harm is done to weak, slow-growing trees, so it is very desirable to promote vigorous early growth by cultivation or release. Spraying with 40 percent nicotine sulphate or a kerosene emulsion is an effective control measure, but usually is not necessary.

COSTS AND RETURNS

The cost of planting cottonwood will vary according to (1) the condition of the planting site and the intensity of site preparation, (2) the availability of planting stock, (3) the need for release and cultivation, (4) the spacing, and (5) the cost of labor. The following itemized estimate is thought to represent the average cost per acre of planting cottonwood 6 by 10 feet on cut-over land, with farm labor at \$2 per day:

Ground preparation	\$ 3.00
Plowing furrows	3.00
Planting stock	2.00
Planting	2.00
Release or cultivation (twice in the first year)	5.00
Total cost	\$15.00

Since there are no mature cottonwood plantations in the Yazoo-Mississippi Delta, returns must be estimated from the best available information. Net returns will of course vary widely according to the value of the land, the tax rate, the cost of planting, the value of stumpage, the volume of timber produced, and even the manner in which net returns are computed. There is, therefore, no possibility of a simple, precise answer to the question of net returns, but conservative estimates should show whether or not there is a sufficiently large margin for profit to make the investment attractive.

It is thought that the greatest average annual growth in board feet is attained at about 35 years, when the yield in fully stocked stands is estimated to be 27,500 board feet per acre, Doyle rule. At \$8 per M board feet for stumpage, this amounts to \$220 per acre. The 3 percent severance tax in Mississippi reduces this to \$213.40 per acre. The per-acre expenditures made in order to obtain this return are estimated as follows:

Planting	\$15 90
Taxes on land	
50c annually for 35 years for land	
protected by the levee.....	17.50
or 5c annually for 35 years for	
unprotected land	1.75
Protection from fire and grazing	
An average of 5c annually for 35 years.....	1.75

Cash expenditures of \$34.25 per acre on land protected by the levee, of \$18.50 per acre on batture land, are therefore estimated to result in a return of \$213.40 after 35 years. The net returns are \$179.25 and \$194.90 per acre, respectively. These figures are deliberately conservative since they ignore additional returns from pulpwood, both in thinnings during the 35-year period and in the final harvest from the tops of sawlog trees and from trees too small for sawlogs. Thinnings alone will probably yield at least 30 cords of pulpwood worth \$1 per cord, and the first thinning will be needed when the plantation is only about 10 years old.

These calculations, like those for most farm enterprises, do not take into account compound interest. It is customary, however, in calculating probable returns from forest plantations to carry all expenditures at a rate of compound interest that it is expected could be obtained from relatively long-term investments. If a plantation can show a substantial net return after computing the costs on such a basis, it is considered a good investment. This method is used in the following table, which again is conservative in ignoring all yields of pulpwood:

**TABLE I. ESTIMATED COSTS AND RETURNS PER ACRE
FROM COTTONWOOD PLANTATIONS HARVESTED AT 35 YEARS**

Item	Land protected by the levee	Unprotected batture land
Interest on cost of land	4% on \$15.00.....\$44.19	4% on \$5.00.....\$14.73
Cost of planting	\$15.00 carried at 4%..... 59.19	\$15.00 carried at 4%..... 59.19
Taxes on land	\$ 0.50 annually carried at 4%..... 36.82	\$ 0.05 annually carried at 4% 3.68
Cost of administration and fire protection	\$ 0.05 annually car- ried at 4%..... 3.68	\$ 0.05 annually carried at 4% 3.68
Total cost	143.88	81.28
Gross return from stumpage	27½ M bd. ft. at \$8.00 per M.....220.00	27½ M bd. ft. at \$8.00 per M.....220.00
Mississippi severance tax	3% of gross return.... 6.60	3% of gross return.. 6.60
Net return from stumpage	213.40	213.40
Net profit	69.52	132.12
Average annual net profit after carrying all costs at 4% compounded	1.99	3.77

These computations indicate that well-stocked cottonwood plantations should prove very profitable. Under intensive management, with frequent thinnings, cottonwood plantations will probably be profitable even on rather costly and heavily taxed land. Cottonwood plantations on cheap, cut-over batture lands offer the greatest promise, however, since plantations on these lands should yield an excellent profit where otherwise little or nothing of value would be produced for a long period.

SWEET POTATO PRODUCTION

MECHANICAL
EQUIPMENT
STUDIES

AGRICULTURAL EXPERIMENT STATION
MISSISSIPPI STATE COLLEGE

CLARENCE DORMAN, DIRECTOR
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SUMMARY

The sweetpotato for food use, for feed, and for starch manufacture, is an important crop in the South. In the Laurel, Mississippi area, sweetpotatoes are grown principally for food and for starch on many small farms in comparatively small patches, and largely by the use of mule methods and equipment. There is direct competition with cotton and other crops for labor during peak periods on these small farms.

From 1939 to 1943, studies were conducted to determine the design, adaptation, and use of equipment in growing sweetpotatoes efficiently and economically. The results of these studies indicate the following:

1. Man labor can be conserved and efficient work done by substituting tractor equipment for the usual 1-mule, 4-furrows per row methods in land preparation.

2. Standard mechanical transplanters can be used profitably for the setting of sweetpotato plants.

3. New designs for planter water valves and opener shoe attachments were developed and proved to be superior to existing designs.

4. Various models of tractor-drawn cart transplanters were designed and tested, making use mostly of junk automobile parts.

5. Designs were developed for direct tractor-attached transplanters.

6. Cultivation efficiency can be improved by the use of a special rotary hoe for early cultivation and tractor-attached cultivator tools for later cultivation, covering at least one row per trip. Equipment already available on most general farms can be adapted for sweetpotatoes.

7. Improved efficiency in harvesting can be accomplished by changes in usual methods of vine removal, plowing-out, gathering, and hauling.

8. Equipment for cutting vines simultaneously with the digging was devised for use with plow or middlebuster and mechanical types of diggers. The equip-

ment requires variation in design and adjustments of diggers, depending upon conditions, and utilization of the crop.

9. Improved efficiency in the use of middlebuster digging of sweetpotatoes for starch use can be accomplished by rod-wing attachments, designed for both mule and tractor models.

10. Plow-type diggers are best for use with sweetpotatoes that are to be stored, and certain adaptations in design and adjustment of operation were worked out for their improved efficiency. The plow bottoms should be broad base, at least 16 inches wide, and must be operated under the row so as to turn out the hills with little injury.

11. A maximum of soil-sweetpotato separation results in much bruising and other injury, which is permissible for sweetpotatoes intended for immediate industrial utilization.

12. Standard commercial models of mechanical Irish potato diggers of the elevator rod-link chain type were found to be suitable for digging sweetpotatoes, provided they are equipped with wide blades, and are operated at the proper depth and chain speed, which vary with field conditions and specific crop requirements.

13. A design for a direct tractor attached mechanical digger was worked out and proved efficient and practical for large acreage growers.

14. Efficiency of gathering depends upon the quality of labor, kind of equipment, and yield of the crop.

15. Untrained labor gathers better after mechanical digging than after middlebuster digging.

16. High yields are gathered with less time per ton than low yields, and a lower percentage of the crop is left in the field.

17. Auxiliary harvesting equipment, such as bagging sleds and carts, field crates, and dump trucks, lower the cost of harvesting by saving time of labor in bagging, crating, assembling, loading, and unloading.

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SWEETPOTATO PRODUCTION: MECHANICAL EQUIPMENT STUDIES

By JOHN W. RANDOLPH¹ and W. S. ANDERSON²

The sweetpotato is the second most important vegetable crop grown in the United States, being exceeded in importance only by the Irish potato. In the southern states the importance of this crop has greatly increased since American participation in World War II, because of the tremendously increased need for food and feed. Every section of this country has been called upon to produce the maximum possible of adapted crops for food, fiber, oil, and feed. Considering the quantity of food units that can be produced to the acre and by a man-hour of labor, the sweetpotato is placed high among the crops that are adapted to the South. Because large quantities of fresh, canned, and dehydrated sweetpotatoes have been demanded for our armed forces, those of our allies, and for lend-lease, they have been designated a war crop in Mississippi. In addition, the increased purchasing power during the war is causing greatly increased consumption of sweetpotatoes by the civilian population. Furthermore, the commercial acceptance, increasing demand, and premium price paid for sweetpotato starch, have resulted in a greatly increased interest in the merit and potential importance of the sweetpotato as a source of domestic root starch.

Except in the commercialized areas, sweetpotatoes have been grown in Mississippi mostly in small patches and virtually by garden methods. Each farmer has been able to fit the necessary cultural operations into his farming program by using family labor or by hiring labor from neighboring farms at times when such labor is more or less idle. Thus, sweetpotatoes have been grown mostly by utilizing labor that would otherwise be idle. This secondary consideration of the

sweetpotato crop has caused the development of relatively few efficient methods and equipment for growing and harvesting. Recent demands for increased production at relatively high prices may be the incentive that will lead to improvements in cultural practices, which, under normal conditions and prevailing prices, will insure a profit to the grower.

Problems of Industrial Utilization

A general industrial utilization of the sweetpotato crop has been delayed by three major factors: (1) the quantity of production has been limited by an inadequate supply of early planting material; (2) the rapid rate of deterioration of the harvested crop, and the accompanying insistence by growers that the manufacturer accept deliveries immediately after harvest; and (3) the high cost of the sweetpotato as a raw material, in relation to the price obtained for the manufactured product.

Extensive industrial use of sweetpotatoes requires that growers produce large yields per unit of land, equipment, and labor used in growing and harvesting the crop. The basis of income to growers is determined by the value of the crop as measured in terms of the finished product. Industrial utilization of the sweetpotato depends upon the cooperation of grower and manufacturer to the end that a factory may be guaranteed an orderly scheduled delivery of the raw material in such a physical condition that will insure a minimum of processing losses. Much of the cost of manufacture depends upon the length of time the factory operates in a season; hence, raw material is needed over as long a period as possible. This is especially true of starch- and feed-making enterprises, because cured sweet-

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potatoes cannot economically be used on account of the relatively high cost of the cured product as a raw material. Starch and feed makers use a semi-automatic, continuous manufacturing process, requiring an orderly supply of fresh raw material. This immediate factory utilization translated to the grower, means that the sweetpotatoes can be handled less carefully and have more mechanical injuries than are permissible in harvesting sweetpotatoes for food use.

Enterprises organized for the dehydration of sweetpotatoes for food, process only cured sweetpotatoes. A minimum of mechanical injuries is a prerequisite for successful storage. This, coupled with grade standards, limits the use of machines and "bulk" methods in harvesting and delivering the crop. Extensive expansion of the industrial utilization of sweetpotatoes would then require actually two distinct methods of production: one for the production of the maximum amount of raw material with little or no grade specifications, and at the lowest possible unit cost; and the other for the production of a high quality product, acceptable for food use.

These two kinds of production could of course be carried on either separately and by different growers, or together and on the same farm. Such production expansion might be accomplished by any of several methods, but is likely to be done by one of the following three described.

Production Methods

Many farmers might make minor adjustments in their farming programs, so that the acreage in one or more counties would be sufficient to produce the sweetpotatoes required for the operation of an industrial plant. Such a plan of production would require many small acreage contracts. In some years, this might result in an excess of raw material and in short crop seasons might cause limited deliveries due to the fact that a large part of the crop would be kept on these small farms for food and feed. Good

business requires that a sweetpotato processor have reliable information on the condition and quantity of the raw material in prospect. It would be desirable, therefore, to render certain field services, and the diplomatic application of fair policies on the part of processor and grower would be required. A centralized production area within a short truck or railroad hauling distance from the factory is a logical condition for any extensive development of the industrial utilization of agricultural products.

Another method for the expansion of industrial sweetpotato acreage would be one in which a relatively smaller number of farmers would modify their farming programs to the extent that their sweetpotato acreage would be sufficient to comply with the requirements of efficient factory operation. Under such a plan, those farmers with large acreages of sweetpotatoes would use the most productive methods and equipment to insure the lowest cost of production. Other growers, by cooperative action, might pool sufficient sweetpotato acreage to benefit by the same changes in their farming programs as the large farmers. The reduction in cost of planting material and of transplanting and harvesting are logical objectives for community effort.

A third method of production leading toward an expansion of the sweetpotato crop for industrial use, is one which might be called the corporation method. By this method the company or corporation who owned and operated the processing factory would acquire, manage, and control sufficient sweetpotato acreage in the vicinity of the factory to guarantee the minimum for profitable operation of the processing facilities. This plan would involve production in large tracts rather than on numerous patches of land, thus affording opportunity for a maximum use of mechanical equipment and power, and a minimum use of man labor. Growing and harvesting operations could be organized and their supervision centralized in such a way that systematic planting,

harvesting, and delivery to the factory could be accomplished.

Cooperative Experiments

It is the purpose of this bulletin to report on experiments designed to study the use of labor, power, and equipment in the growing and harvesting of sweetpotatoes. These experiments have been carried on during the past five years by the cooperation of the Mississippi Agricultural Experiment Station and the Division of Agricultural Engineering, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture. The objective of these investigations has been to develop efficient and economical methods and equipment for the production and harvesting of sweetpotatoes for food, feed, and industrial utilization. The work has been directed primarily toward the problems of labor and cost reduction in growing sweetpotatoes for starch manufacture. The studies have concerned the adaptation of existing farm implements and the development of new methods and equipment for the specific jobs of land preparation, transplanting, cultivating, and harvesting. Most of the studies were carried on in connection with the growing of sweetpotatoes for the starch factory at Laurel, Mississippi, but it is believed the results are applicable to other similar areas.

Description of Area Where Studies Were Made

The farms surrounding Laurel may be considered as typical of the agricultural development which usually follows a diminishing lumber industry. In some cases large blocks of land are still held in this area for reforestation. There are some large-scale farming operations, but most of the cut-over lands have been divided into small farms. In general, each farm has a limited cultivated acreage, and often the fields are small, rolling, and irregularly shaped. This recently timbered area contains many farms which have excellent crop production re-

cords. However, most fields require liberal fertilization and good farming practices if high yields are to be secured.

Many minor variations in type of enterprise and size of farming operations have developed. However, the general and diversified type of farming followed is illustrated by the organization of crop acreage recommended by the Jones County Policy and Planning Committee. The crops and acreages recommended for a two-mule farm by this committee are as follows:

Cotton	40 acres
Corn	15 acres
Sugarcane	2 acres
Truck crops	3 acres
Starch sweetpotatoes	4 acres
Soybeans or peanuts	3 acres
Cowpeas	3 acres
Home garden	1 acre

Such a two-mule farm would usually have available the following farm equipment:

- 1 10- or 12-inch plow
- 1 6- or 7-inch plow
- 1 10-inch middlebuster
- 1 spike-tooth harrow
- 1 mowing machine
- 1 hay rake
- 1 fertilizer distributor
- 1 combination one-row planter
- 2 spring-tooth cultivators or side harrows
- 2 plow stocks
- 1 wagon
- 1 one-half-ton pick-up truck

The labor requirements for crop production in this area are approximately the same as those required for other sandy loam soils of the South, with similar use of power and equipment. Information on the labor requirements for Jones County has been published in Mississippi Agricultural Experiment Station bulletins 269, 276, and 352. A study of the labor requirements on a typical Jones County farm reveals that insufficient time is available for the two-mule farmer to handle all of the acreage of the crops recommended by the Planning Commit-

Table 1.—Hours available for field work at Ellisville, Mississippi, in certain months of 1942.*

Week ending	Average length of day in hours	Days lost by rain	Total available hours for work	
			Week	Month
January	4	9.8	3	0
	11	9.8	1	49.0
	18	10.0	0	60.0
	25	10.2	0	61.2
February	1	10.4	1	52.0
	8	10.5	0	63.0
	15	10.6	0.5	58.5
	22	11.0	3.5	30.2
March	1	11.2	3.3	30.3
	8	11.6	3	34.8
	15	11.8	4.5	16.8
	22	12.0	2	48.0
	29	12.5	0	73.8
April	5	12.5	1	62.5
	12	12.8	3.3	34.5
	19	13.0	0	78.0
	26	13.3	0	79.8
May	3	13.5	0	82.0
	10	13.7	0	82.0
	17	13.9	2	55.6
	24	14.1	0	84.6
	31	14.2	0	85.2
June	7	14.3	2	57.2
	14	14.5	4	29.0
	21	14.5	1	72.5
	28	14.6	4	29.2
July	5	14.6	0	87.6
	12	14.6	3	43.8
	19	14.4	0	86.4
	26	14.2	3	42.3
August	2	13.9	1.5	60.6
				233.1

*/Time based upon payroll records, soil conditions in hill fields, and other sources of information, compiled by William M. Roberts, formerly Junior Engineer, United States Department of Agriculture.

tee, considering the machinery available, the methods practiced, and usual rainfall. The data in table 1 show the time by weeks and months available for field work as influenced by hours of daylight and occurrence of rains, and table 2 shows the labor requirements of the typical farm acreage, recommended by the Jones County Planning Committee.

A study of tables 1 and 2 reveals, further, that cotton and sweetpotato crops are in direct competition for labor during the spring and fall months. Such competition is of high importance. In gen-

eral, the cotton crop is the Mississippi farmer's first-choice cash crop, and other crops seem of little importance until he has a satisfactory stand of cotton and it is clean of weeds. Any assistance he receives on methods of handling the cotton crop during this crucial period would greatly ease his mind and put him in a more favorable mood for growing other crops. For generations it has been the custom of the Jones County farmer to prepare the land for and plant the cotton crop regardless of other crops. Only a few do plowing and other spring till-

Table 2.—Man-hours of labor required on a Jones County farm, growing the 1942 recommended crop acreage, using typical small machine units, basis of published Mississippi Agricultural Experiment Station data on average requirements per acre of specified crops.

Operation	Month	Cotton 10 acres	Corn 15 acres	Sweet- potatoes 4 acres	Sugar- cane 2 acres	Soy- beans 3 acres	Cow- peas 3 acres	Total
Make bed	March	—	—	68	—	—	—	68
Care of bed	March	—	—	10	—	—	—	10
	April	—	—	29	—	—	—	29
	May	—	—	50	—	—	—	50
	June	—	—	25	—	—	—	25
Land preparation	March	40	90	—	24	—	—	154
	April	80	—	8	—	24	35	112
	May	—	40	18	—	—	—	58
	June	—	—	21	—	—	—	21
	July	—	—	—	—	—	—	—
Fertilize and plant	March	—	82	—	—	—	—	82
	April	41	57	20	7	18	19	161
	May	—	—	65	—	—	—	65
	June	—	38	56	—	—	—	94
Cultivate	April	50	50	—	10	—	—	110
	May	110	50	7	23	14	5	209
	June	60	39	16	10	6	—	131
	July	21	13	10	—	—	—	44
Hoe	April	30	30	10	—	—	—	70
	May	160	17	24	37	—	—	238
	June	29	10	38	10	—	—	87
	July	—	—	20	—	—	—	20
Harvest		557	120	225	275	75	110	—
Total		1178	636	700	396	137	168	—

Summary

Month	Man-hours required	Hours available	Deficiency
March	314	236	78
April	482	373	209
May	620	307	313
June	358	276	82
July	64	233	—

age work during favorable periods of weather in January and February. March is commonly accepted as corn planting time. The cotton land is prepared for planting in the last half of April; until May 15 or 20, cotton chopping, replanting, and cultivating are the average farmer's chief interests. In normal times there is some flexibility in the supply of labor, and members of the family or extra day laborers are used in critical periods. During the war, however, there are definite limits to what a farmer can do with

available labor, methods, and equipment. Comparison of the hours available as shown in table 1 and the hours required as shown in table 2, shows that the average farmer is in dire need of assistance in the form of adjustment in enterprises, or in improved methods and equipment, or in both. The apparent deficiency of labor shown for March might be made up by working on "rainy days" on the sweet-potato hotbeds. Nevertheless, to till the recommended acreage table 2 indicates that the farmer must have extra help in

April for 209 man-hours of work, in May for 313 man-hours of work, and in June for 82 man-hours of work.

Since increased farm production is essential during wartime, and in view of the scarcity of labor, efficient practices and labor saving equipment are of the highest importance. Farmers are referred to Circular 540, published by the United States Department of Agriculture, for information about the use of efficient labor saving methods and equipment for fertilizer application and seed planting for cotton. The information presented in the following pages describes methods and equipment for use in efficient production of sweetpotatoes.

Land Preparation

Pre-crop tillage operations for sweetpotatoes may be accomplished with the equipment ordinarily used in cotton production, with which all southern farmers are familiar. In general, the only

difference in result is that the sweetpotato row is thrown-up to a somewhat higher ridge than that used for cotton planting. A future publication will report on experiments now under way to measure the effect on yield of different methods and conditions of land preparation.

Figure 1 illustrates the development of a 4-furrow ridge as commonly done with a small plow. This method results in very satisfactory ridge preparation, and is objectionable only because of its man-labor consuming feature. Some growers ridge the land by this method without preplowing broadcast, but in general, they either double disk-harrow or plow it before ridging. Standard middlebusters mule or tractor type, will throw up high ridges on narrow rows at one trip per row, but an objection to their use is that the standard row ($3\frac{1}{2}$ to 4 feet wide) is too wide for a high and well-formed ridge to be prepared at a single trip with the middlebuster. The hollow center ridge



Figure 1. Ridging land with a small plow at four furrows per row.



Figure 2. Ridging land with disk hiller attachment on tractor cultivator, one trip per row.

produced by this method forms a trench into which an excessive number of wind-borne weed seeds are deposited, thus tending to increase future crop cultivation operations.

Broadcast plowing permits the use of several forms of rapid tillage to keep down weeds before ridging, especially for midseason planted crops. Land that has been plowed broadcast can be ridged easily with disk hiller attachments on a mule drawn one-row cultivator or on a standard tractor cultivator, as shown in figure 2. This equipment saves time because only one trip is required to ridge a row. It is possible also to apply fertilizer on the same trip with fertilizer attachments to the cultivators at only a small increase in the time required per acre.

The gang disk attachments shown in figure 3 will throw up a higher ridge at a single trip per row than the one

set of hillers shown in figure 2. This unit works well on either broadcast plowed or land with little pre-tillage. The sugar-cane bedding attachment shown in figure 4 will also construct a ridge of satisfactory height and width for sweetpotatoes. In using any of the disk hiller attachments for ridging, the speed of operation affects the pulverizing action and the height of the ridge thrown up. The faster the movement, the higher will be the ridge and the greater the pulverization.

Mechanical transplanting seldom follows immediately after the ridging operations, and the delay may permit a growth of weeds. Experience has shown that it is advantageous to prepare the ridges somewhat higher than is desired for planting and then, with a flat or sharp implement, drag off the top directly in front of the transplanting operation, as shown in figure 9-B and in figure 10-B. This action throws the weeds and trash from previous crop residues into the row middle and provides a fresh moist location for the plants. The use of the drag harrow with vertical setting of the teeth is objectionable because it makes grooves in the tops of the ridges which cause the soil to dry out faster and which interfere with the operation of the transplanter opener.

Transplanting

Data published in bulletin 378 of this Station show that getting the crop of sweetpotatoes planted contributes more to the cost of production than any other set of operations. These data also show that for close hill spacings the plants alone are the largest item in the total cost, determine the yield because of their relation to planting time, and represent a large part of the total labor requirement. Of course, the wider the hill spacing, the less does the plant cost contribute to the total; also, it is important to note that the hill spacing of plants influences greatly the time required for planting an acreage, whether by hand or machines. Thus, on the average one lab-

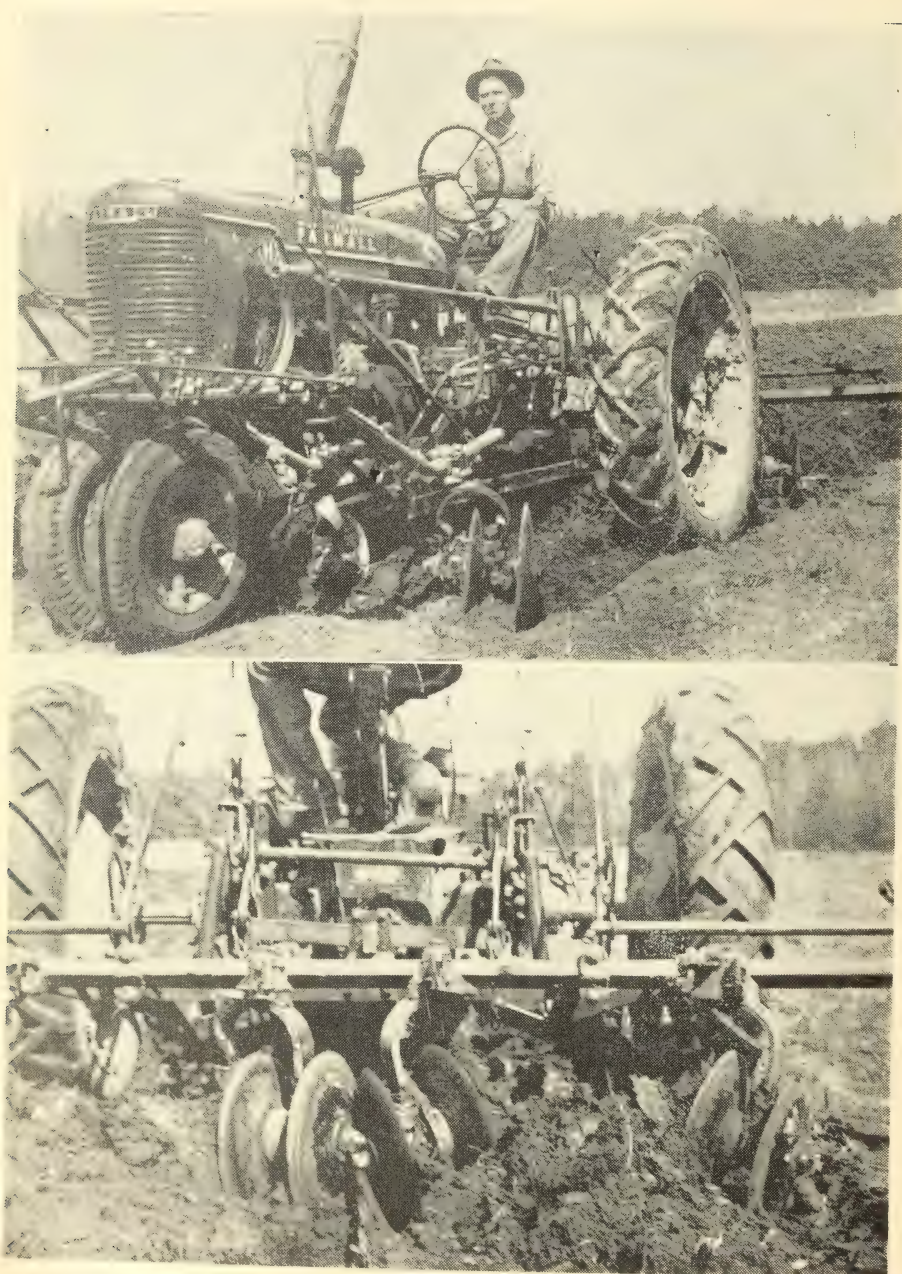


Figure 3. Ridging land with front and rear gang disk attachment. Two rows at each trip.

Table 3.—A practical application of plant production data to indicate bedding requirements in bushels.

Measure or requirement	Carefully handled seed stock	Not carefully handled seed stock
Plant production per bushel at second pulling	213	65
Bushels required for 1 acre, 8,000 plants	38	123
Bushels required for a 2-row transplanter for 10 hours of operation, 72,000 plants	338	1108

orer can pull and bunch 850 plants per hour, and 10 man-hours would be required for pulling alone if the spacing required 8500 plants to the acre.

In order to show the relation between plant production and transplanting methods and equipment, the data in table 3 have been prepared from information published in bulletin 349 of this Station. These data indicate that in order to keep a 2-row transplanter operating during a single 10-hour day from a single (the second) pulling, 338 bushels of good, carefully handled seed stock of the Triumph variety would have to be bedded and kept under optimum conditions.

Another relationship between plant production and transplanting, is illustrated by figure 5, which shows typical Triumph sweetpotato plants grown for setting in the Laurel area. The long, overgrown plants shown at "A" in figure 5, were developed on time borrowed from the next pulling; such plants are too long, too crooked, tangle in the hands of plant setters, and seldom live when set out. If they live, they interfere with early cultivations and grow off too slowly. Plants that are too short and bushy give plant setters trouble in handling. It is best to have plants that are 7 to 10 inches long, having mostly clean stems and with the top and root about equal in length, as shown in "B" of figure 5. From the standpoint of low labor requirement in mechanical transplanting, such plants as are shown in "C" of figure 5, trimmed to a pencil-like condition, are the most satisfactory. However, the advisability of such trimming as a general practice is questionable because of the difference of varieties in their ability to withstand transplanting, varying weath-

er conditions at planting time, and soil conditions.

One cause of difficulty in mechanical transplanting is "grab-pulling," or the pulling of a handful of plants at a time. The efficiency of transplanting depends upon the plant setters having well separated plants of uniform size, fresh, and available in orderly arrangement. "Grab-pulling" not only gives a mass of tangled plants impossible to use with any degree of accuracy on a mechanical transplanter, but reduces the future plant production of the hotbed. There is little chance for a plant setter who is properly and accurately placing 40 to 60 plants per minute to separate or cull out the small or otherwise undesirable plants. Vine cuttings give more trouble in mechanical

**Figure 4.** Ridging land with a sugarcane bedding attachment, a complete row per trip.



Figure 5. Typical Triumph sweetpotato plants grown for setting in the Laurel area.

transplanting than do sprouts. Tip cuttings in full leaf are especially difficult to handle. Mid-vine cuttings are usually very crooked and tend to become tangled. If the leaves are removed from the vine cuttings, they are easy to handle in transplanting, but removal of the leaves causes poor stands, since many plants die before new leaves are produced.

Any plants set late in the afternoon are known to survive better than those set during the forenoon or early in the afternoon. Small growers practice setting their crops in the afternoon only, but large growers require more than such limited time. The use of tractors equipped with lights to operate the transplanter would make it feasible for the transplanting crew to work until late at night, taking their rest in the forenoon, and thus enable large acreages to be set during the most favorable period of the day.

Hand Transplanting

Experiments conducted cooperatively between the U. S. Department of Agriculture and the South Carolina Experiment Station, reported in U. S. Depart-

ment of Agriculture Circular 327, showed that time of transplanting has a significant effect upon yield of sweetpotatoes in South Carolina. Data presented in bulletin 378 of this Station and in bulletin 348 of the Louisiana Agricultural Experiment Station show definitely that time of transplanting is important in sweetpotato yields. A graphic summary of these data for Mississippi and Louisiana is presented in figure 6. The reduction in yield shown as a result of delaying the planting proves definitely that low-cost sweetpotato production cannot be obtained except with early transplanting of the crop. Hand transplanting, in addition to the competition with cotton for labor, has caused growers to delay transplanting until too late for a profitable yield to be made.

Notched stick methods. The usual practice in hand transplanting is for the grower to prepare the land, then wait until there is sufficient moisture present to insure a stand without the application of water. If the soil is moist, however, transplanting may be done as soon as the

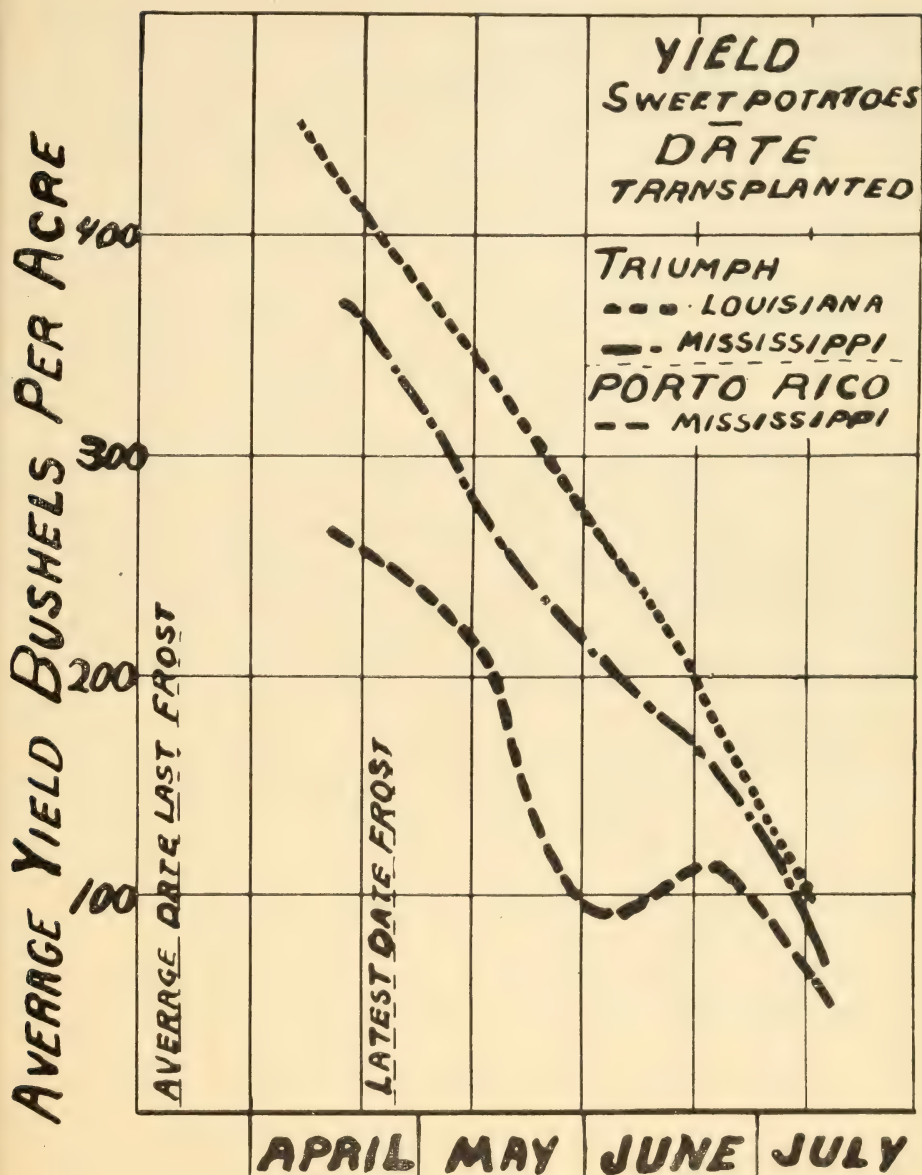


Figure 6. Curves showing yields of sweetpotatoes reduced by delaying planting.

preparation is completed. In hand transplanting, one worker lays or drops the plants across the row at the desired hill spacing, and a second worker uses a notched stick to force the plant roots into the soil and firms the soil about the roots

with the planting stick or with the foot. A typical transplanting crew, using these hand methods, is shown in figure 7. Sometimes the soil is too hard for easy "sticking out," in which case the plant roots are cut by the stick, and poor stands

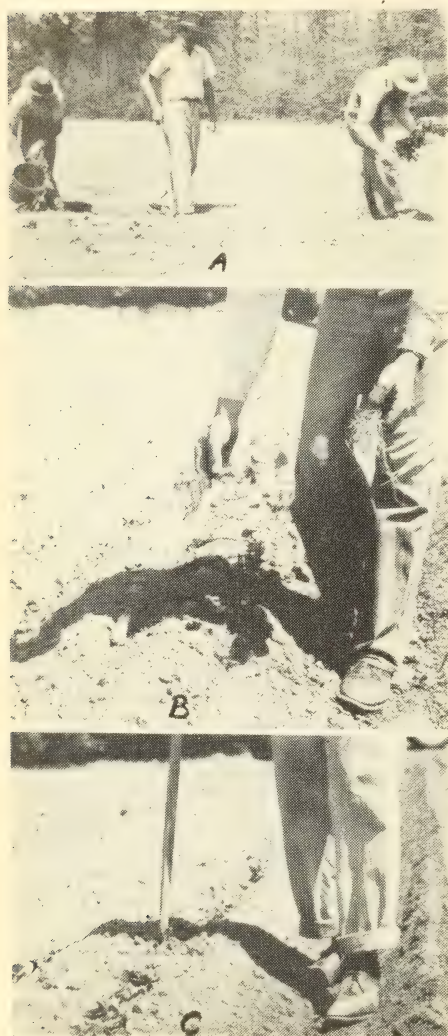


Figure 7. Hand transplanting by the "drop and stick" method: A. Dropping, sticking-out, watering. B. Dropping. C. Sticking-out.

result because these damaged plants fail to live.

Hand transplanting requires much labor, but the efficiency of different farm crews varies greatly. A study of 35 farm crews showed that 18.2 plants per minute was the average dropping rate in long periods of work. A good coordination of the movements of the hands and feet is

necessary for fast dropping and for sticking out plants. Some droppers can accurately space on the seedbed 40 to 60 plants per minute, but the over-all rate of dropping is usually greatly reduced because the dropper must frequently obtain supplies of plants from the ends of the row or from other storage locations. On this account one worker sticking out at the rate of 14.1 plants per minute can keep up with two workers at the average dropping rate. An average of the work of 37 farm crews showed that for the actual transplanting, where plants were already at convenient locations in the field, the average rate was 6.4 plants per man-minute. Records of hand transplanting where water was used showed much variation, because, in general, growers use water as a last resort because they are not properly equipped for watering. An average of 27 farm crews showed that 48.9 man-hours were required to set out an acre with water. The range was from 38 to 105 man-hours per acre. The average was 20 hours higher than was required by 24 similar farm crews without watering.

Trowel methods. In these studies several experiments were conducted to determine a suitable substitute for the practice of hand transplanting with a notched stick. The garden trowel was found to be a superior tool for opening and closing the bed for the transplant. This method showed an average of 21.4 plants set per minute under 20 representative farm conditions. Laborers, however, usually do not like to use the trowel method because of the requirement that they stoop to set the plants.

Hand machines. Combination transplanting and watering can be done with simple low-cost hand equipment. One commercial hand transplanter tried in these experiments is shown in figure 8-A. This unit has a tube through which the plant is dropped into a hole in the row made by clam-shell blades. Hand levers attached to the water compartment of the unit operate the blades and the water



Figure 8. Hand transplanting: A. With commercial transplanter. B. Experimental transplanter. C. Details of transplanter shown at B.

valve. Since sweetpotato plants have rather large leaves and crooked stems, they do not easily slide down the tube. Care in pulling and selecting the plants would make the use of this device practical for the small grower. Records of the time required to set plants with it showed that 4.04 plants per minute could be set when extra plants and water are located on the ends of rows 200 yards long. With 16-inch hill spacing this rate would equal 38.5 man-hours per acre.

The hand transplanter shown in figure 8-B was built in an effort to duplicate the notched stick method of setting plants. This unit is not difficult to construct, as shown by figure 8.C. Under the conditions tested this transplanter required 26.9 man-hours to set an acre at 16-inch hill spacing or the rate was 5.78 plants to the minute. It is not believed that this unit could be operated successfully by children. It is heavier and more

difficult to carry than the commercial unit shown.

Mechanical Transplanting

The mechanical transplanter has been in use for setting vegetable and tobacco plants for many years in many parts of the United States. Very few machines have been used to set sweetpotatoes in Mississippi, perhaps because growers seldom have a large enough acreage to justify the purchase or renting of a machine. Growers in the Laurel area have expressed several objections to commercial mechanical planters, claiming that such machines (1) will not plant close enough to the end of the row, especially where a fence occurs; (2) will not follow curved and irregularly shaped rows; (3) are not satisfactory for planting "point" rows (necessary in terraced fields); (4) are difficult to pull at a steady slow speed with the average small mule team; (5)

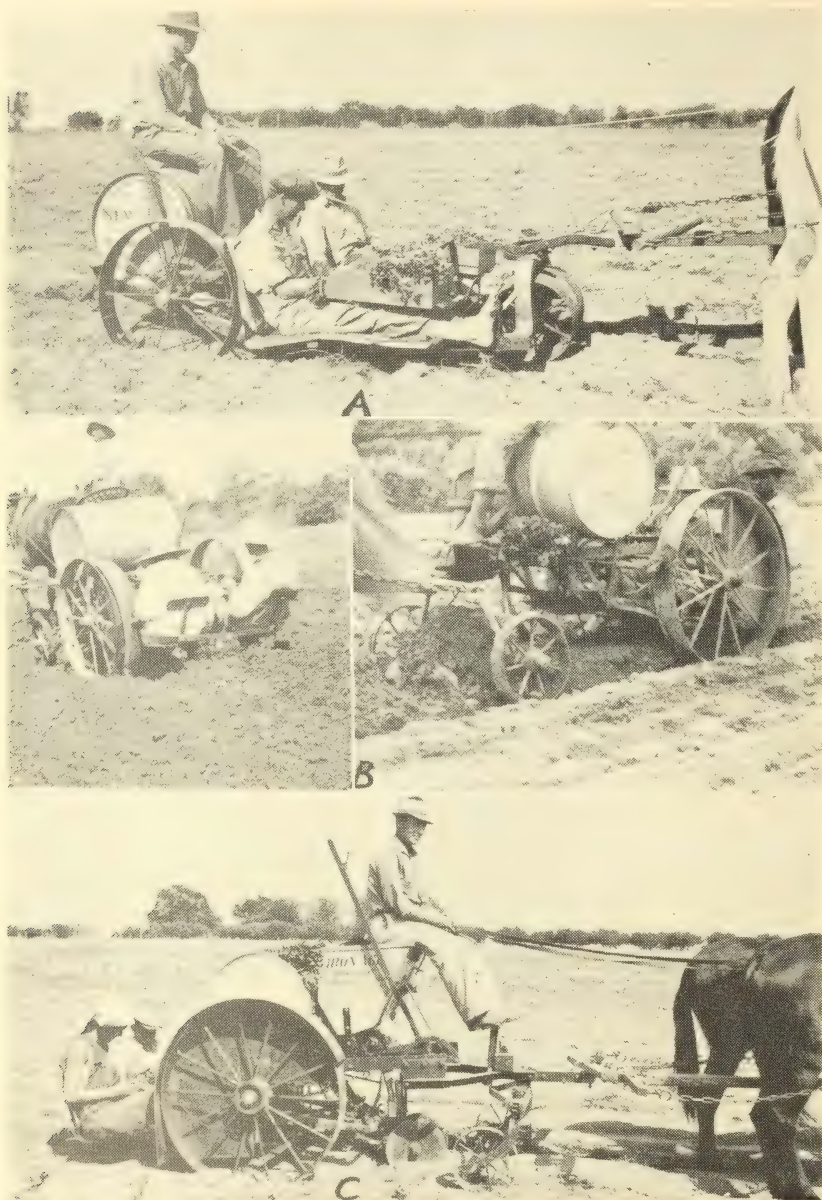


Figure 9. Three commercial transplanters showing: A. The design for the plant setters to be in front of the tank. B. The design for the setters to be in the rear. C. Facilities for applying fertilizer at the time of transplanting.

require skilled laborers, which are difficult to train; (6) do not satisfactorily and consistently fill the furrow and compact the soil around the plants; and (7)

do not work satisfactorily in fields where there are stumps, trash, and crop residues.

Many of the objections of growers to the use of mechanical transplanters are

the same as those encountered in the introduction of other labor saving farm machines and methods, and, in the end, some satisfactory adjustment can usually be worked out. The machines are either re-designed to meet the specific requirements of the growers or the crop program is so adjusted that the machine fits the type of work the grower wants it to do. Some growers in the Laurel area have made changes in their farming practices, and these growers usually plant sweetpotatoes on land that is free of stumps and otherwise adapted for the satisfactory use of mechanical transplanters. The use by such growers of improved farm machinery, including tractors, has caused them to lay out the rows so that point, short, and curved rows are reduced to a minimum, and the rows are uniform in width. In a limited way the advantages of mechanical transplanting have reached the small growers who cannot afford to own a transplanter. A few growers have produced surplus plants, and have sold them mechanically transplanted by trained crews. The Laurel Starch Plant has, since the first season of its operation, produced large quantities of plants for planting by the contract growers as a method of insuring that the factory would have sufficient raw material for operation. In addition, the plant has recently purchased transplanters for hire and loan to growers.

There are three general arrangements in design of commercial transplanters. These are illustrated in figure 9. The machine shown at "A" in figure 9 is made so that the plant setters are located in front of the water tank and the main wheels. This arrangement permits the driver to make quick adjustments in the speed of row travel to equalize the variable ability of the plant setters, due to the condition of the plants or soil. This type of machine has a relatively long wheel-base, which is undesirable when planting sharply curved rows, point rows, or when crossing terraces.

Another standard design of transplanters is that shown in "B" of figure 9.

This machine provides for the plant setters to work at the rear. This arrangement allows for the maximum of space for the plant setters, but has the disadvantage of removing the plant setting work from the view of the driver, thus reducing the opportunity to vary the speed of travel in keeping with the needs of the plant setters.

A third standard design in transplanters provides for the simultaneous application of fertilizer at planting. This type of machine is shown in figure 9-C, and is equipped with a fertilizer hopper on the front, with suitable distributing spouts, furrow opening disks, and the necessary adjusting devices for varying the method or rate of application. This machine design offers distinct opportunity to save labor in the preparation of land on the average two-mule farm. (On such farms fertilizer is applied as a separate operation with one man and one mule; whereas, with this transplanter equipment, it can be applied at the transplanting.) With tractor-equipped growers this advantage of fertilizer application could not be claimed because the standard tractor equipment provides appliances for putting out fertilizer simultaneously with land ridging or with transplanting when a cart transplanter is used. A disadvantage claimed for this transplanter is that the load is so heavy that there is excess side wheel slipping on soft, sandy, and hill-side fields, making its control difficult.

Changes in transplanter design. In trials of the commercial transplanters described and illustrated above, the need for changes in design for their adaptation to the various conditions found in the Laurel area was suggested. The upland soils in that area vary widely in physical condition. In fact, frequently a single row varies from end to end in soil condition at the time of transplanting. At one place the machine may work satisfactorily, and at another place on the same row may be found a spot where the soil is much more sandy and here the openers and coverers must be adjusted for satisfactory work. Different fields

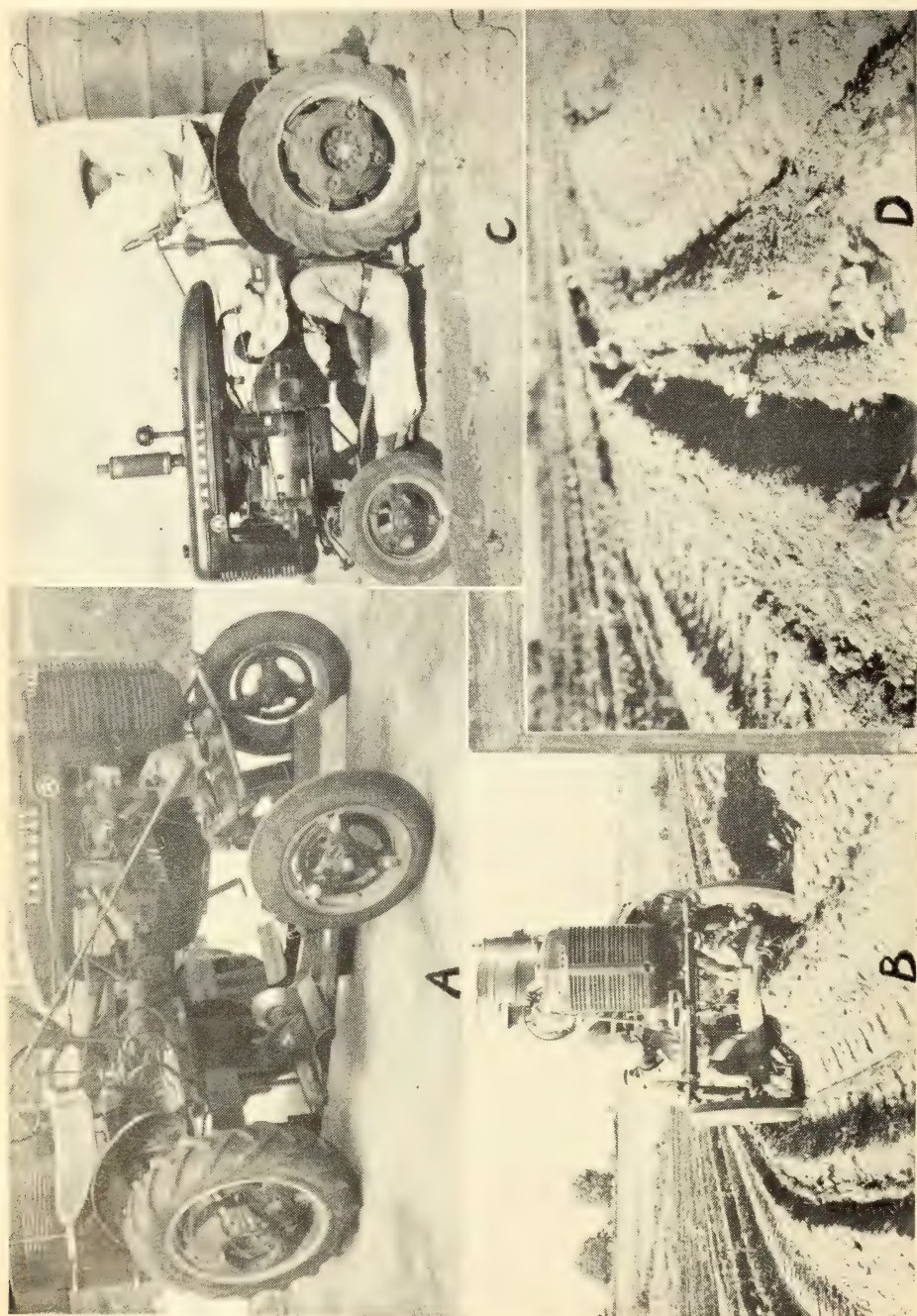


Figure 10. Transplanter designed for direct attachment to a one-row Farmall tractor: A. Side view of complete unit. B. Front view of unit in operation. C. Side view of transplanter in operation. D. View of transplanted row.

present varying conditions, and transplanters should be so designed that the various working parts are capable of quick adjustment. The fertilizer openers, the planting shoe, and furrow coverers, all should be subject to ready adjustment. Furthermore, the fertilizer furrow openers and the transplanting shoe should be capable of separate adjustment. Because soil variations also influence preceding tillage operations, a mechanical transplanter should be capable of operating with simple adjustments on either flat land or rows ridged high. The machine should be designed for ease of handling in the field. It should be capable of making short turns, of being easily backed, and should follow the power unit closely. Because sweetpotatoes are grown in rotation with corn and cotton crops, the soil working units of the transplanter should be so designed that they will not be clogged by crop residues in the soil.

With the above problems in mind,

work was undertaken to improve the work of commercial transplanters and to design new ones that would more nearly meet the requirements for sweetpotato transplanting in the hill area of Mississippi. Since the war has limited the supply of new farm implements available, these designs have provided for the use of non-critical materials as far as possible. In plans for and in actual construction of the experimental transplanters described in the following pages, liberal use has been made of junk yard materials, especially such materials as are found in connection with junked automobiles. This work is the result of no direct contribution by implement manufacturers. Some of the developments, however, represent ideas borrowed from machines designed for other crops and purposes.

Modifying commercial designs. In working with the commercial transplanter shown in figure 9-C, it was found possible to greatly improve it by changes

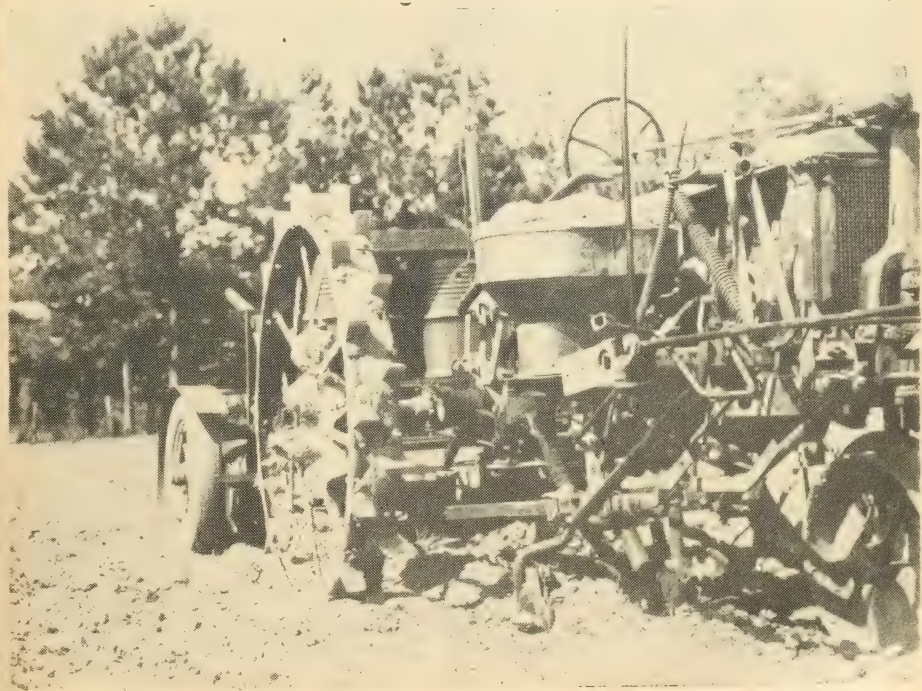


Figure 11. Standard general purpose tractor showing use of cultivator equipped with disk hillers preparing ridges as fertilizer is applied and plants set in rear.

in design. The fore truck and horse hitch were removed and a tractor hitch was provided. It was more serviceable as a tractor drawn cart machine than in its original design. Next, this machine was practically rebuilt so as to embody some of the features of the design of the grain drill; that is, it was so changed that the original single lever control of the fertilizer furrow disks and the planting shoe were replaced by two independently controlled units. Short, easily adjusted levers were made to control each of these units, making it possible to vary separately the fertilizer attachment and the planting openers according to the conditions obtaining.

Experimental designs. One type of transplanter which was designed in these studies, in cooperation with K n o x Vaughn, a contract grower, is the direct-attached tractor transplanter shown in figure 10. As is shown, this transplanter unit was supported by attachment in

place of the standard cultivator frame to the front of the tractor, and depth adjustments are readily obtained with the standard cultivator adjusting lever. The unit consists of two seats, a furrow opener, covers, water barrel with mechanism to give the desired distance-interval discharge of water in the furrow, and a ridge-smoothing bar. Under all conditions tried, this unit met the requirements for transplanting in irregularly-shaped fields. It allowed satisfactory control of all planting operations by the tractor driver, and proved to be one of the most efficient transplanters used in these studies. Because the general purpose tractor on relatively small farms must be quickly changed from job to job, this direct-attached type of transplanter may be adapted only to those farms where sufficient sweetpotato acreage is planted to warrant keeping the attachment on one tractor intact during the transplanting season. Further, this



Figure 12. Trailing cart transplanter, built on an old model automobile front axle.



Figure 13. Trailing cart 2-row transplanter. A. Barrels set on end. B. Barrels horizontal and connected, giving a uniform water flow.

type of transplanter has the disadvantage of not permitting the ridging and fertilizing operations to be done simultaneously with transplanting. It is a saving of labor to do these jobs as illustrated by figure 11, and many tractor owners prefer not to have the cultivator attachments replaced by transplanter

equipment. Most growers in the Laurel area have relatively large acreages of cotton and corn which are necessarily cultivated in the normal sweetpotato transplanting period. The logical procedure in any adaptation of the general purpose tractor to sweetpotato growing is to make the maximum use of standard equipment



Figure 14. Trailing cart 2-row transplanter, with canvas (old sacks) shade over plants and setters.

and attachments designed for the other crops, and to take advantage of seasonal requirements; hence, no effort was spared in these studies to make all possible use of the tractor attached equipment.

Several types of trailing cart transplanters have been designed, built, and tried out under farm conditions prevailing in the Laurel area. Figures 12, 13, and 14 illustrate four 2-row experimental machines which differ little in essentials of design. The one shown in figure 12 was built on the front axle and wheels of a very old model Buick automobile, while late model Ford front axles and wheels were used in building those shown in figures 13 and 14. These are all low-cost machines, most parts for which were made from junk automobile parts. The few other items are easily obtainable from the average hardware store. Water tanks used were discarded oil drums.

The framework construction for all cart transplanters, while similar in principle, may be quite different from that

shown, depending on the automobile parts used. The pictures shown should suggest the principle involved. The detailed drawing, shown in figure 15, of a typical 2-row cart transplanter can be used as a guide in the adaptation of the equipment available for building a transplanter. Some of the essentials that may be mentioned are the provision of a framework of ample strength, the arrangement for maximum clearance for the plant setters, and the construction of accurate water valve opening mechanisms, furrow openers, and covers.

Figure 16 illustrates an experimental one-row transplanter which was built by a modification of the trailing cart plan. This machine was provided with a team hitch in the form of a tongue instead of the fore-truck hitch as is the standard for horse-drawn commercial one-row transplanters. It was also provided with a common "knocker" type plow stock fertilizer distributor attached in front and to one side of the furrow opening shoe.

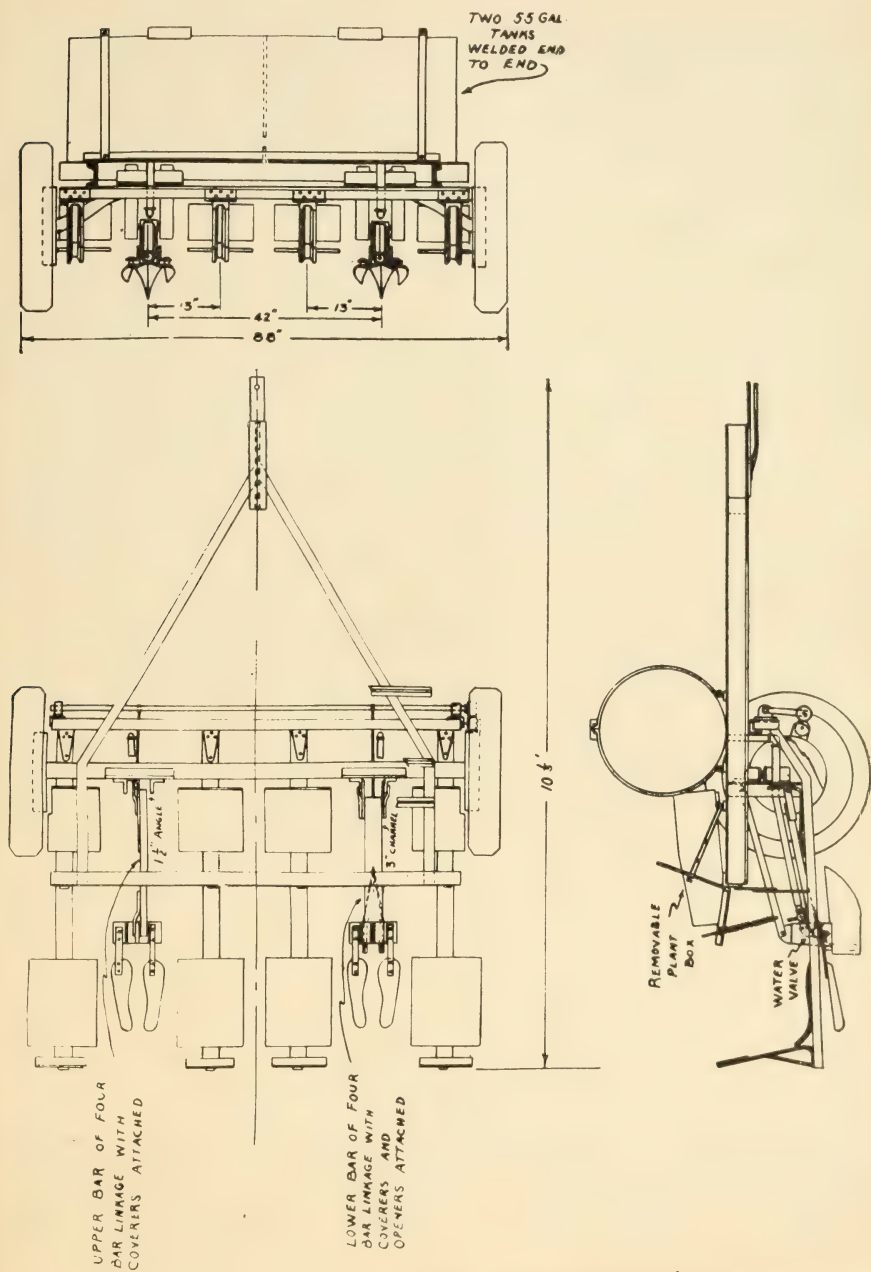


Figure 15. Drawing of a trailing cart two-row transplanter.

This allowed fertilizers to be applied to the side of the plant in a single band at the desired depth. This machine did not prove satisfactory under the conditions

of the trials made. The two barrels of water amounted to too much weight for the average small sized team to handle properly. Also, because of the two-wheel



Figure 16. Experimental one-row horse-drawn transplanter. A. Front view. B. Rear view.

design and the uneven height of the tongue during operation, depth of the soil opener could not be controlled with necessary accuracy for good plant set-

ting. Some advantages of this type are that of labor saving because of the fertilizer attachment, compactness, and maneuverability.

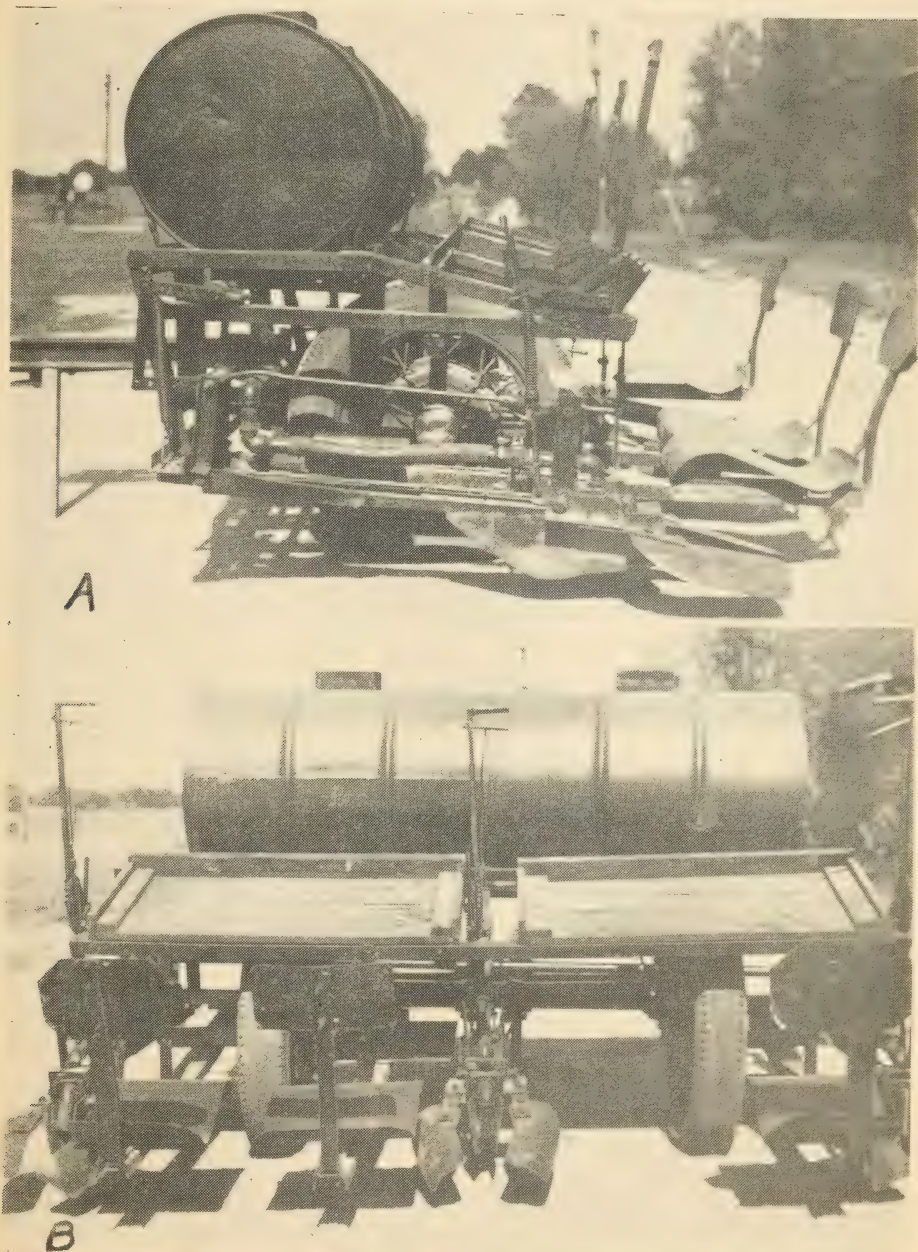
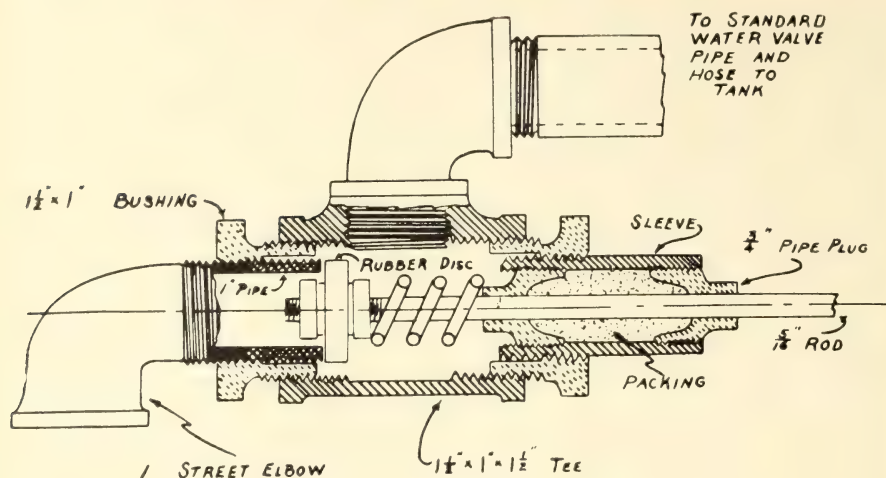


Figure 17. Three-row transplanter. A. Side view illustrating four-bar linkage. B. Rear view.

Another experimental cart type transplanter which was built in these investigations is the 3-row machine illustrated by figure 17. This machine was con-

structed on an automobile front axle and wheels, adjusted in width to fit the standard 42-inch row. The narrow cart design and the arrangement of two barrels



WATER VALVE ASSEMBLY

Figure 18. Construction details of shop built water valve, designed for use on transplanters.

on sides as a single water tank, made the machine very compact, and easily handled in the field. The design shown provides for three seats only, and thus presumes the setting at hill distances and under other conditions wherein each plant setter could take a row alone. To provide for six plant setters would mean the loss of the advantage of compactness and of handing. Only skilled plant setters, therefore, could be used on such a machine. Attention is called to the wide table provided immediately in front of the plant setters, which permits an arrangement of the plants in such a fashion that each setter can work for long periods of time without a stop for obtaining plants. Under average field conditions and with skilled plant setters, this machine was found to be very efficient. A rate of 180 plants per minute could be maintained with accurate work, considering no loss of time for obtaining plant and water supplies and for end-of-row turns. Taking these time losses into consideration, an average rate of 82 plants per minute was obtained for complete setting. This rate is equivalent to the transplanting with three setters in one hour all of the plants secured from an average

second pulling from 100 bushels of ordinary seed stock.

A new water valve design. The commercial transplanters tried, and the earlier experimental machines contained certain features of design that made them expensive, difficult to build in some cases, and caused certain difficulty in operation. Much work has been done in an effort to correct these faults in design, with special attention to the water valve and its opening mechanism, and to the furrow-opening unit. The water valve unit designed and used satisfactorily in the experimental transplanters is shown in detail by figure 18. This valve unit is simple in construction and is made almost entirely of ordinary pipe fittings and used auto parts, the only exception being the soft rubber disk necessary for closing the valve tightly. This disk is usually obtainable at large hardware stores or mill supply houses. Other parts needed include a used auto brake rod, and one old valve spring. Any pipe fitter can readily make up the assembly with his ordinary tools. The furrow opener and coverers with the installation of this water valve assembly are shown by the drawing in figure 19. This illustration shows

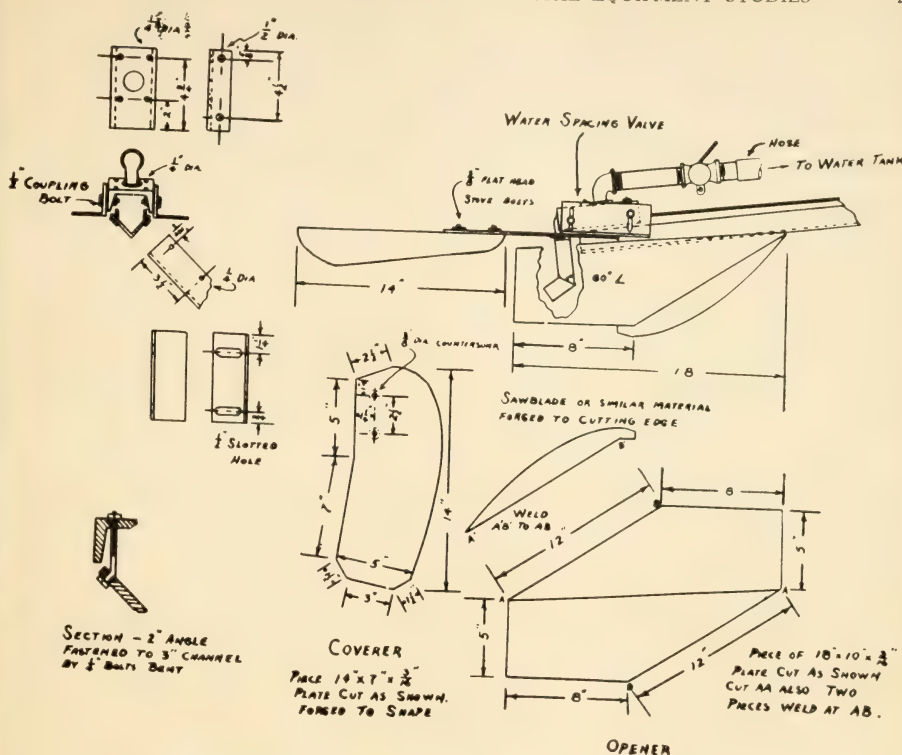


Figure 19. Detailed drawing of opener, coverers, and valve installation.

the furrow opener as a fixed unit attached to the pull bar. Such an arrangement is suitable for planting only on a seedbed in a uniform condition. Figure 20 shows one method of developing the attachment of the forward part of the pull bars of the opener shoe. This attachment to the main frame of the transplanter allows the water valve operating mechanism to function through the pivot point of the unit.

A new furrow opener unit design. Extreme ranges in ridge height and other field variables have resulted in the design of an opener unit so as to make use of the four-bar linkage principle, illustrated by figure 21. The chief advantage for this type of design is that in its operation the pressure for the furrow opener comes directly from the main frame of the transplanter. Also, the covering plates are functioned by the four-bar linkage which keeps them level regardless of row height. Furthermore, trash or other

obstructions that might lift the opener shoe are released by the spring of the upper bar as soon as the obstruction comes in contact with the coverers. The use of the four-bar linkage design has proved very satisfactory under all conditions where it has been tried.

Water valve opening devices. The mechanism (operated by the ground wheel) which regulates and controls the opening of the water valve, is usually the only part of a mechanical transplanter which gives trouble in regular operation. The extent of such trouble hardly justifies the development of a special dust-protected mechanism and the use of special treated metals. Detailed suggestions for three suitable devices are given in the drawings shown in figure 22. The frequency of the valve opening, which determines the distance of the hill-spacing, depends upon the number of cam rollers and the circumference of the trans-

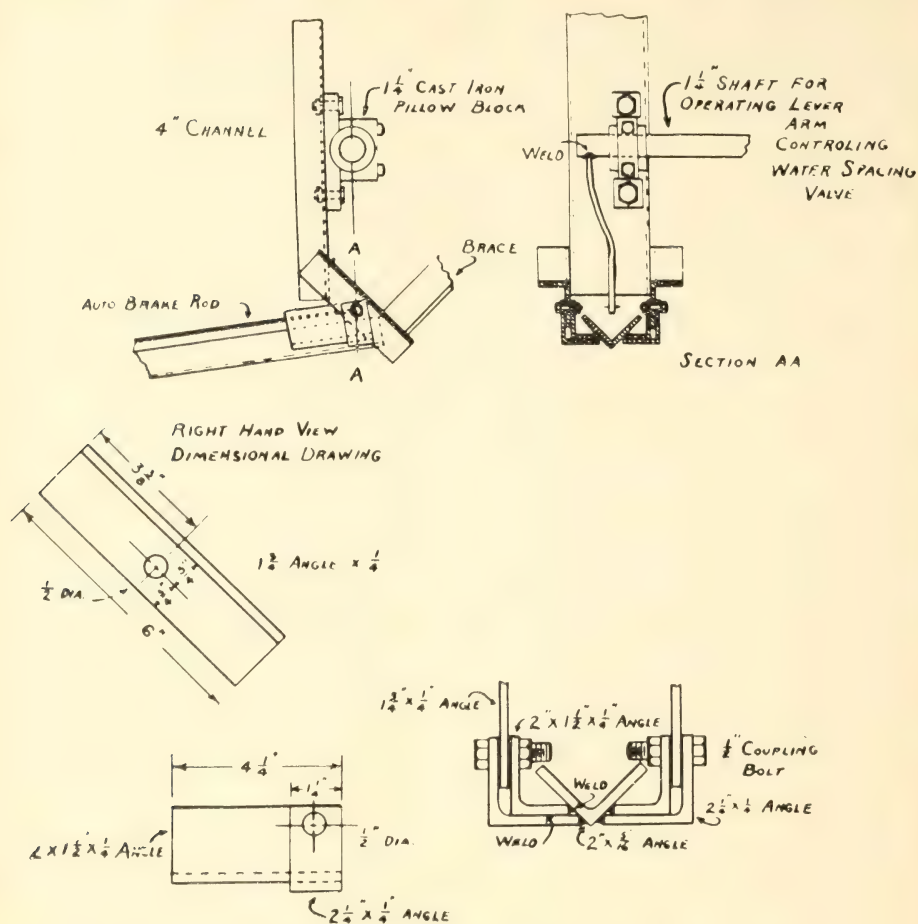


Figure 20. Drawing of front assembly for opener shoe.

planter wheel. The amount of the valve opening is a factor of linkage in the mechanical connection levers to the valve, and should be easily adjusted. The length of time the valve is open depends upon the cam-roller contact, and will vary with the speed of movement of the machine. When two rollers are used instead of one and a cam, quick discharges of water will result on account of the short period of valve opening.

Furrow filling devices. In the work with experimental transplanters, some observation has been made of the effectiveness of various furrow filling devices. The repacking of the soil into the fur-

row around the plant roots is an important part of the transplanting operation, and frequently determines the success of mechanical transplanting. Standard coverers are either press wheels such as are shown in figures 10 and 16, or "duck-back" plate coverers as shown in figures 17, 19, and 20. Commercial machines are equipped with either, depending upon the preference of the purchaser. Both types have been tried on the experimental machines. The plate coverers give good results under all conditions where the soil will shed easily and fold readily around the plant roots. In trashy and cloddy soil, the press wheels will do more satis-

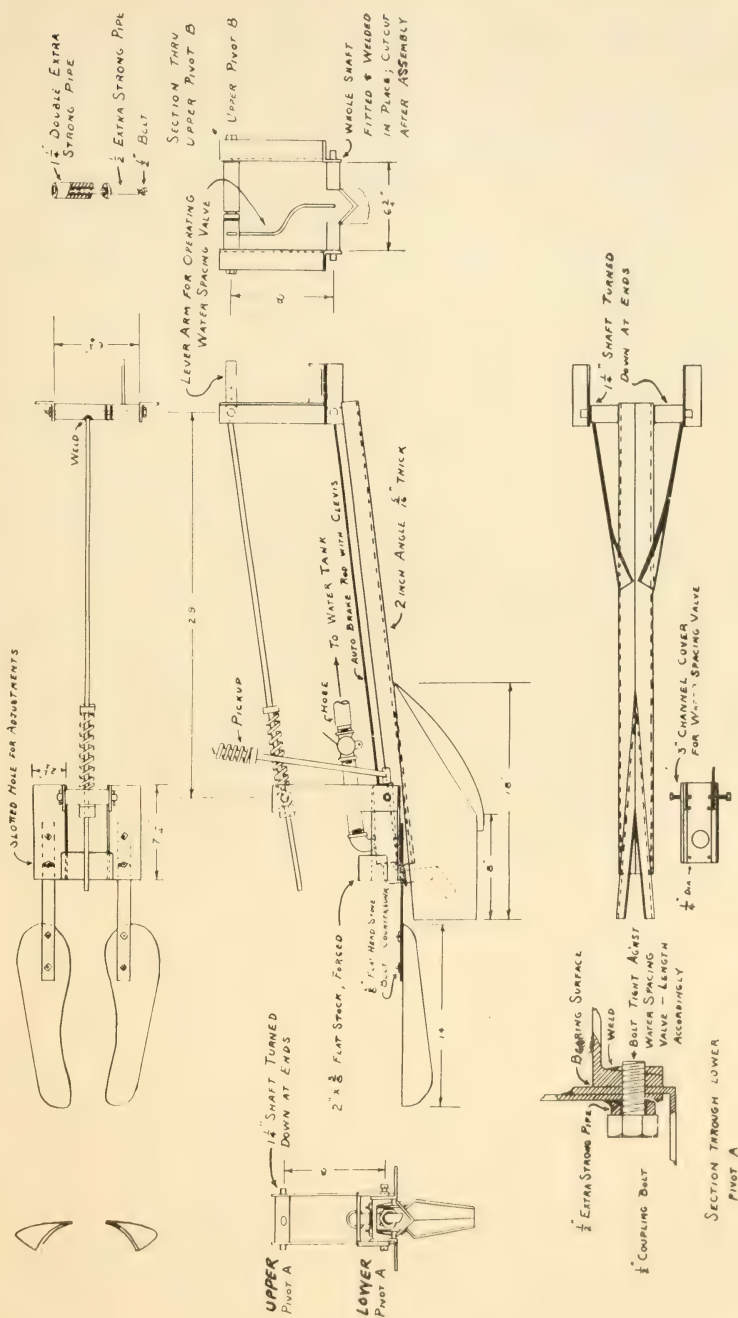


Figure 21. Detailed drawing of four-bar linkage transplanter attachment.

factory packing, but the increased possibility of injury to the hands causes plant setters to work more slowly with press wheels than with plate coverers. A study of the rates of 77 planting crews showed that the rate of setting with press wheel coverers was 89.2 percent of that when plate coverers were used.

Under some soil conditions both types of coverers described fail to firm the soil around the plant roots well enough to insure a complete stand. The replanting of skips is tedious and expensive, and hence is to be avoided. There is need for further study of furrow filling and packing mechanisms for the purpose of improving the designs.

Because the work of transplanting must be closely centralized within the length of the setter's arm, the machine designer is definitely limited in possible designs of the unit. If the mechanism could be made longer and if its width

were not controlled by the need to give seat space and freedom of movement to the setter's body, the furrow opener and furrow filling devices could be constructed so that they would work satisfactorily over a wide range of soil conditions. The plant setters should place the plant roots deep into the furrow and in center of the area of soil filled with water. The whole unit, therefore, must be made so that it is convenient for the plant setters to set the plants accurately.

Semi-automatic transplanters. The transplanters described depend upon hand placement of each plant in the correct location in the furrow. Realizing the need for eliminating more of the human factor in setting plants, a semi-automatic transplanter was obtained and tried in the planting season of 1943. This commercial machine, illustrated in figure 23, makes use of transplanting pockets for mechanically placing the plants into the

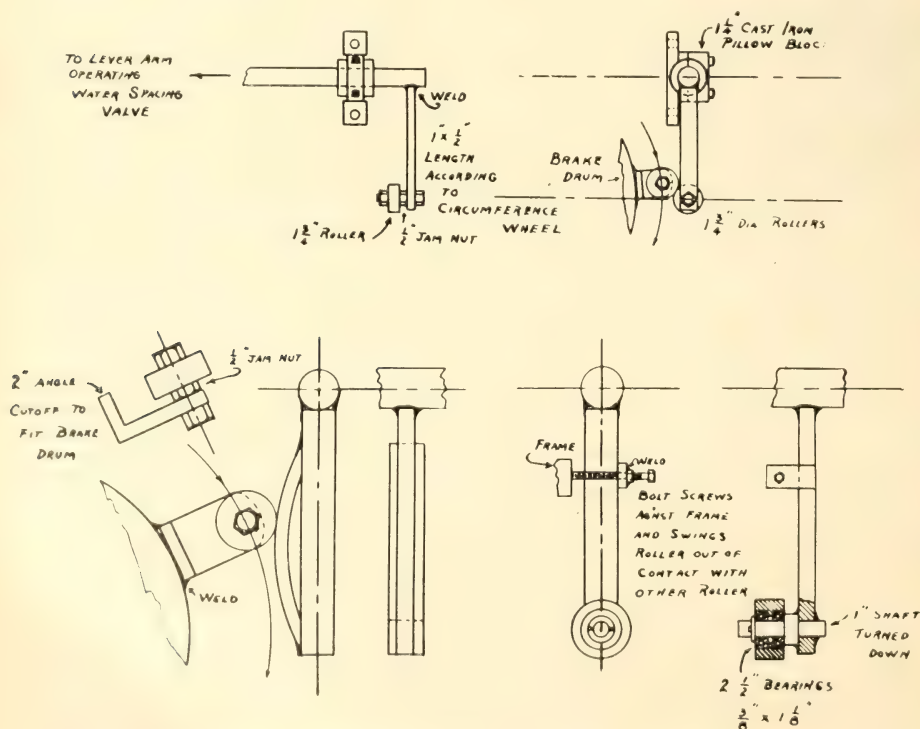


Figure 22. Suggested devices for opening water valve.

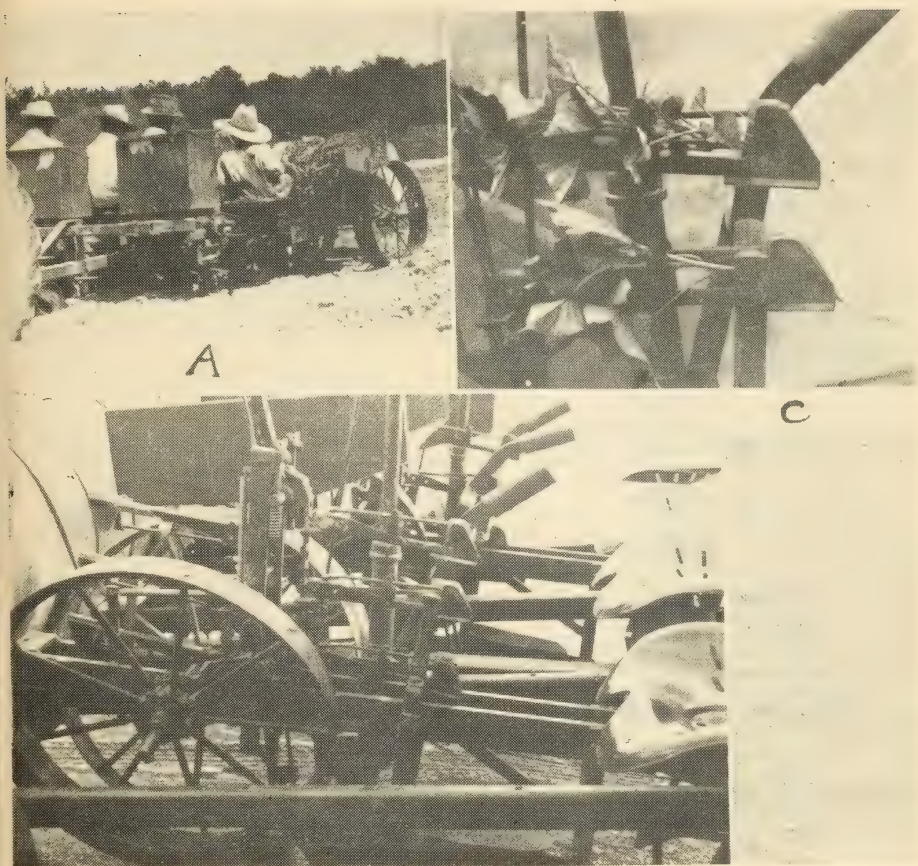


Figure 23. Commercial semi-automatic transplanter. A. General view of unit in operation. Bottom, Side view of planting assembly. C. Transplanting pockets.

furrow in exact timing with the opening of the water valve. These pockets consist of metal arms equipped with shapes for holding the plants and delivering them to the furrow. A sprocket driven chain is used to move the arms in and out of the furrow. A convenient location is provided for the work of the plant setters, who must only place the plants in the pockets when they are directly in front of the setters. This transplanter has been used successfully for setting celery plants in commercial celery areas on smooth clean land for many years. One season's trials, however, failed to show that it is superior to the

common transplanter for sweetpotatoes. It was found that workers who cannot accurately set plants on an ordinary transplanter, could not place them in the pockets of this machine. The extra mechanical devices provided no particular advantage for skilled or unskilled plant setters.

Factors Influencing Transplanting Efficiency and Cost

Watering. In studying the various problems in connection with transplanting sweetpotatoes, it has been observed that the job of watering is time consuming and expensive. Hauling the water supply to the field and transferring it to

the transplanter tank is responsible for most of the expense of watering. More than a third of the total time required in mechanical transplanting is used in supplying water to the machine, if hauled in barrels on a wagon or truck, according to observations in the Laurel area. Table 4, section I, presents data which show the time required to haul water with different types of equipment. These data, calculated to man-hours per barrel of 55 gallons of water, show that 5 growers averaged about one-fourth of a man-hour per tank by using barrels on a wagon. If two men make the trip with a 2-mule wagon, this amounts to a cost of approximately 10 to 14 cents per tank.

The use of a truck to haul the barrels does not reduce the time appreciably, because most of the time required is consumed at the ends of the trips rather than in going to and from the source of supply. The data show that with a tank on a truck or a trailer and equipped with a hand pump for loading and unloading, the time required is greatly reduced, in some instances to as low as one-tenth of a man-hour to the tank. The tractor-drawn tank trailer unit shown in figure 24 is equipped with two lines of hose attached to a hand pump and has a capacity of 500 gallons. This outfit was used in connection with experimental planting in 1942 and represents the 13

Table 4.—Factors influencing mechanical transplanting costs.

I. Hauling water to the field; time of trip and securing water

Containers	Transportation unit	Number of cases	Man-hours per 55 gallons
Open barrel	Sled and mule	2	.390
	Wagon	5	.264
	Half-ton truck	7	.268
	Large truck	4	.250
270-gallon tank	Truck and power pump	6	.106
500-gallon tank	Truck-trailer, tractor, hand pump	13	.105
500-gallon tank	Truck water from city hydrant	5	.199

II. Filling transplanter tank, including turn and stop

Source of water	Equipment	Number of cases	Man-hours per 55 gallons
Farm well	Hand pump, buckets or hose	11	.837
	Buckets	7	.419
Ditch	Buckets	27	.542
	Big funnel and dump barrel	7	.348
Barrel end of row	Gravity, 1½-inch hose	2	.445
	Hand force pump and hose	31	.318
	Power force pump and hose	3	.244

III. Placing sweetpotato plants on machine, trimming and arranging

Type of plants	Man-hours per 10,000 plants
Small plants in good order	1.03
Long plants in good order	5.03
Medium size plants, had been heeled out	4.60
Long and short plants "grab-pulled"	9.30

IV. Time lost in row travel to arrange plants on machine

Type of plants	Percentage of row travel time
Short to medium size plants, in good order	Good plant setters and 2 men per row very little time lost
Twenty-one farm crews, average	23.1 percent lost time

V. Other rates

Operation	No. of cases	
Turn machine at ends of rows and arrange plants	Many	2.94 minutes, time lost
Transplanting, 2 men per row	112	54.1 plants per minute
Apply fertilizer with attachment	5	2.13 man-hours per ton

cases shown in table 4 with an average of 0.105 man-hours per transplanter tank.

After the water has been hauled to the field, considerable time is usually consumed in transferring it to the transplanter tank, depending upon the facilities, methods and equipment used. In table 4, section II, data are presented to show the effect of type of equipment and source of supply upon the hours required to fill a transplanter tank. It is seen from these data that twice as much time is required to fill the tank with buckets from a farm well as from barrels at the end of the row, because the time for driving the transplanter to the well and return must be counted against filling the tank. The time required is greatly reduced when the barrels are dumped into the tank by the aid of a large funnel, instead of by dipping with buckets, and is about as quick as filling from a large tank with a hand pump and hose. A 4-inch hand force pump and hose to fill from a large tank was found to be the fastest way to fill a transplanter tank. This latter type of equipment has doubtful application because of its cost except for very large acreage growers.

Condition of plants. The data in table 4 show that the type and condition of plants have a significant effect upon the time required to place them on the machine, trim, and arrange them for convenience in setting. They show that only about one hour per 10,000 plants is required if the plants are small in size, arranged in order, or bundled. If the plants are long, but reach the field in good order, five times as much is required. Heeled-out plants, because of their tendency to tangle and to be disorganized, require nearly five times as much time for arranging on the machine as small fresh-pulled plants delivered in an orderly batch. Mixed-size plants that have been "grab-pulled" and hence are tangled and unorganized require more than 9 hours per 10,000 for arranging.

These data are significant, because of the indicated saving of time by certain



Figure 24. A water hauling tank trailer. Note the hand pump on rear platform and two lines of hose.

plant conditions, and further because when plants are placed on the machine in an orderly and convenient arrangement, few extra stops are required along the row by skilled plant setters. It is important that the machine be kept moving as much as possible. The data show that when short or medium-sized plants are arranged in good order, skilled setters on a one-row machine required no stops until the carried supply is exhausted. An average of 21 farm crews, covering almost as many different plant conditions, showed 23.1 percent of the operating time lost in stops to arrange plants.

Condition of soil. Soil condition affects the time of transplanting, regardless of the type of machine, kind of plants, or skill of the operators. Hard, cloddy seedbeds do not work well with any kind of openers or coverers and hence slow down the work of the whole planting operation. Soils which are very variable in texture from row to row or on the same row cause time losses because of the necessity for stops for changes in machine adjustments. This is illustrated by the data in table 5, section II. These data show for a two-row transplanter that three times as much time is required to set an acre when the soil is variable or dry and cloddy than when it is in good condition.

Table 5.—Mechanical transplanting data.

I. One-row transplanter: all field work included					
Conditions			Number of records	Man-hours per acre	
				Average	Range
Average of 1939-1943 inclusive			22	14.5	5.7 to 32.0
Farmers owning machine over 5 years, 1943 average.....			5	9.3	6.8 to 11.8
Farmers owning machine over 5 years, using machine in moist soil, no water			3	4.5	3.5 to 5.7
II. Two-row transplanter: all field work included					
Conditions				Acreage covered	Man-hours per acre
Size of crew	Soil moisture	Plants	Hill spacing, inches		
A. Water hauled in 500-gallon tank on truck or truck trailer					
5	dry	fresh, good size	25	3.0	5.56
5	dry	fresh, long	25	1.8	6.47
5	wet	fresh, good size	25	—	3.08
5	dry	heeled out plants	25	5.5	9.21
5	medium	fresh, trimmed	25	3.0	5.06
5	medium	extra long, trimmed	25	2.6	8.66
5	variable	variable	25	18.0	8.80
5	dry	wilted-variable	25	2.0	9.83
5	medium	"grab-pulled"	25	7.0	9.07
B. Water obtained at field ditch					
5	medium	fresh, good size	25	2.0	6.25
5	medium	fresh, good size	25	6.0	4.01
5	dry	vine cuttings	25	4.0	7.09
5	dry	trimmed vine cuttings	25	4.7	5.50
C. Water hauled in 500-gallon tank					
3	medium	fresh, good size	25	1.7	6.80
3	medium	fresh, good size	25	4.0	4.10
D. Water obtained at field ditch					
3	dry	fresh, good size	25	4.2	3.68
3	dry	fresh, short	25	1.2	4.69
3	dry	trimmed vine cuttings	25	4.0	4.42
3	medium	fresh, long	25	3.2	6.12
3	medium	fresh, mixed sizes	25	1.7	4.93
3	cloddy	fresh, good size	25	1.5	4.08
E. Water hauled in 500-gallon tank					
5	medium	fresh, good size	12.5	7.0	5.85
Average of above conditions					6.06

Skill of operators. Another factor which influences the time required and hence the cost of transplanting is that of the experience and skill of the operators. The plant setters must have the ability to synchronize their arm movements with the clicking of the water valve in order properly to place their plants so that good stands will be obtained. Many people do not have this ability and cannot be trained to become skilled at the work of transplanting. Others acquire this skill readily. The owner-operator of a transplanter

must learn all of the adjustments, applications, adaptations, and limitations of mechanical transplanters in order to be able to operate the machine efficiently. The data in table 5, section I, show the advantage of experience and skill in transplanter operation. Twenty-two farm crew records showed a range of 5.7 to 32.0 man-hours per acre for transplanting. The average was 14.5 man-hours, which is 56 percent more time than was required by growers who had owned transplanting machines for 5 years or

longer and hence operated with skilled crews. Of course, when watering is not necessary, much time can be saved, as is shown by the average of three experienced growers who set in wet soil at 4.5 man-hours per acre. The ability of the operator to organize and supervise the crew in all of the operations cannot be over-emphasized in the efficiency of sweetpotato transplanting.

Size of transplanter, of course, has some effect upon the cost of transplanting, but taking all farm crews and conditions together, the data do not show that size of machine is as important as the other factors discussed. Thus, the average time required for all of the conditions shown in table 5, section II, where 2-row machines were used, was 6.06 man-hours per acre, and some growers can plant an acre in half that time with the same machines. Furthermore, some growers who obtain maximum efficiency can set an acre with a 1-row machine in approximately 4 man-hours.

Cultivation

Requirements for Sweetpotatoes

Sweetpotatoes, being a transplanted crop, present more problems in connection with cultivation than do row crops grown from seed, principally because of the usual prolonged planting period. There is ample time under average farm conditions for weed growth to become established on sweetpotato fields before planting unless frequent cultivation is practiced. In addition, the sweetpotato does not stand weed competition during the early stages of growth, and clean cultivation is necessary if good yields are to be secured.

Land preparation is one of the most effective means of weed control. These operations will force weed seedlings to develop early in the season when they are easily killed, and will bring roots and rootstocks of perennial weeds to the surface where they may be killed by exposure. When land preparing operations are conducted over a long period, each

soil stirring kills one crop of weeds and other weed seeds are induced to germinate so that they can be destroyed before the crop is transplanted. After the crop is planted, the cultivation procedures should be sufficiently flexible to meet varying requirements.

It has already been pointed out that sweetpotato and cotton crops compete directly for labor in the spring months. Soil types usually planted to these crops often have the undesirable characteristic of forming hard crusts after rains. These crusts prevent young cotton plants from reaching the soil surface. The usual procedure of the farmer is to "side-harrow" the cotton while it is emerging. Several types of commercial harrows can be used to break this crust and aid the young plants to develop, but they are mostly half-row or at best 1-row units and, besides requiring excessive time, do not accomplish the best results.

The rotary hoe is a most satisfactory implement for breaking crusts on flat land, and has a low man-hour per acre requirement. The standard rotary hoe, however, is not suited for satisfactory operation on ridged land, especially in small irregularly shaped fields where the rows are short and curved. The toothed wheels of this implement have been used in designing a 1-mule, 2-row rotary hoe which has been found to be a very serviceable cultivation unit because of its wide adaptability for use in small fields on row crops in the hill areas. It is flexible, has a light draft, allows the covering of two rows at a trip, and is relatively easy and cheap to build. Figure 25 gives details of the construction of this unit and illustrates its use in the early cultivation of sweetpotatoes. Many of the dimensions shown in the detailed construction drawing in figure 25-B can be varied to fit the materials available. The essentials to be remembered are that a suitable frame is needed, with shafts and plow handles attached, and that four of the hoe-wheels are assembled for running on top of each row, as shown by figure 25-D.

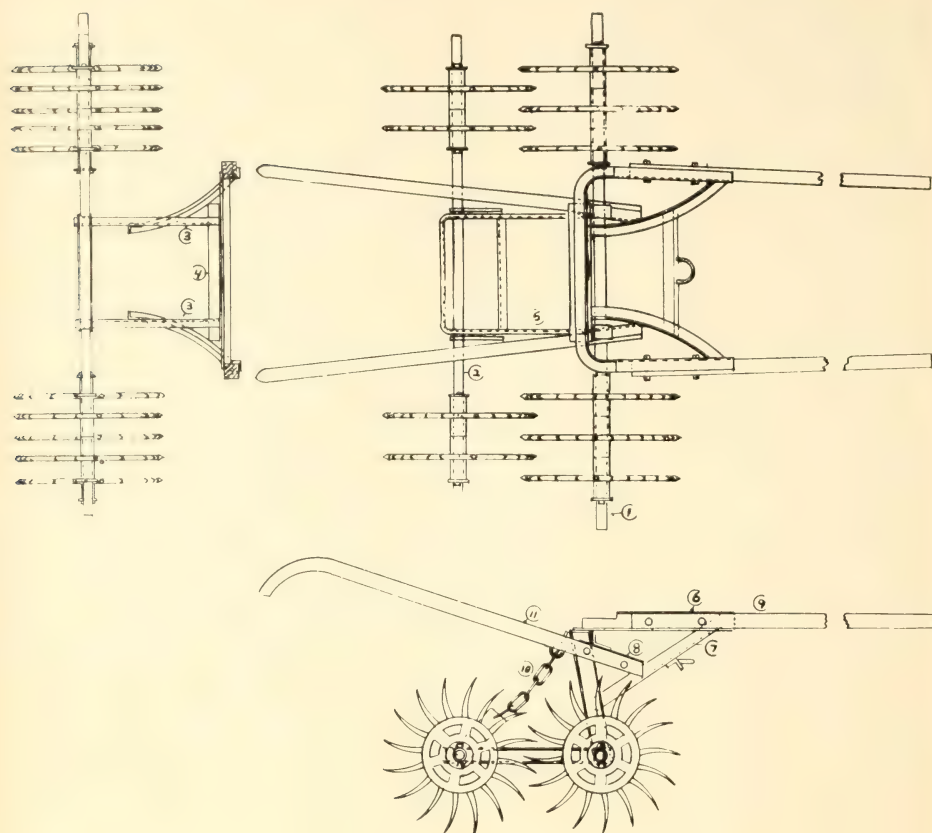


Figure 25-A. Modified rotary hoe: Construction drawing.

Figures 25-C and 25-D show this rotary hoe in operation in sweetpotato cultivation in the field where, although the plants were only recently set out, there is a well-formed soil crust and many germinating weeds and grass. The illustration shows that this implement effectively breaks up this crust along the top of the row. This can be done with little or no injury to good plants that have been properly transplanted. Plants that have not been properly set and are not well established may be pulled or thrown out of the soil. In the case of cotton cultivation, plants which are weak on account of disease attacks on the stems will usually be knocked out, thus actually aiding the thinning operation. It is possible

for one man and one mule to cover as much as 20 acres of land in one day by using these implements. Its use on cotton-sweetpotato farms would do much to enable farmers to handle the cultivation of both cotton and sweetpotato crops.

Later cultivation for sweetpotatoes differs from that for other crops mainly by the necessity to work under vines spreading across high-ridged rows. High ridges not only make for better yields, but also are an advantage in harvesting. The best time for ridge construction, that is, whether in preparation for planting or during cultivation, is a problem for future experiments. The desirability for high ridges is an advantage in cultivation, because it affords an opportunity to shift

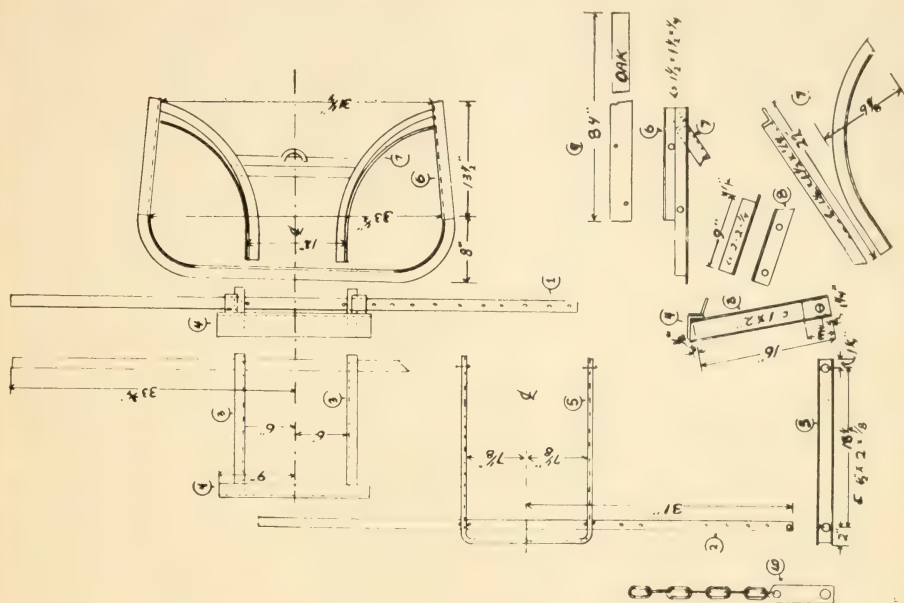


Figure 25-B. Modified rotary hoe: Detailed plan drawing.

soil toward the row and thereby smother out weeds and grass that would otherwise require removal with hoes.

Sweeps. The cultivation of sweetpotatoes having rather long vines, including the shifting of soil toward the row, may be done by using certain types of sweeps or other flat tools, and with little injury because the vines are floated about on loose moving soil. The small-grower practice of turning the vines into alternate middles for cultivation is so labor consuming that it cannot be economically done.

Laurel area methods. The majority of fields of sweetpotatoes grown in the Laurel area are cultivated with one-mule equipment. The first cultivation is generally that of "side-harrowing" with a spring tooth unit, such as is shown in figure 26. This cultivation soon after transplanting, can be made very effective in the hands of a skilled plowman who can virtually plow out or cover up all small weeds and grass on the row. If done this well, such cultivation can eliminate much of the hoe work. The mid-

dle and side-of-bed cultivations are customarily made with various ground working units attached to a plow stock such as is shown in figure 27. These attachments may be small sweeps for side row work and large heel sweeps with small lead shovels or only large solid sweeps for the middle cultivation. Some growers use plows and middlebusters to turn under rank weed and grass growth. These local practices require many trips up and down a row, and thus make for very high total labor requirements.

Cultivation equipment experiments.

Figure 28 illustrates a large heel sweep and solid sweep combined attachment for plow stocks which was developed by the junior author for cultivating small experimental plots in 1935. The heel sweep for use in this unit should be wide enough for the cultivation of an entire row at a single trip. The regular plow stock heel sweep shown is 36 inches wide, and has been reshaped and reinforced to give complete cultivation to the sides of the adjacent ridges. Much of the normal twist in shape near the attach-



C



D

Figure 25. Modified rotary hoe: C. Operation of unit. D. Close-up view showing work of tool.

ment bolt has been removed to increase the unit's plow action and decrease the cutting action. The intention in the use of the sweep is to plow or move soil up and along the edge of the ridges. The range or height of this action is controlled by the setting of the angle of the plow stock foot and by installing the heel sweep directly under the 10- or 12-inch solid sweep. It is usually necessary to reinforce these heel sweeps by welding a bar between the wings. The illustration shows this unit adjusted so that the

end of the heel sweep wing is approximately ten inches from the ground, or from the level of the point of the front sweep. When properly adjusted and kept well sharpened, this unit provides for deep soil working action in the center of the row middles, a shifting of the soil into the sides of the ridges, and a shallow cultivation next to the row and well under the vines. A single operation per row with this unit is equivalent to three usual cultivations by half-row methods. One special advantage of this unit is that, in proper operation, it does not injure the vines. A disadvantage is that its successful operation depends upon uniform row spacing, shape of ridge, and adjustment of the unit.



Figure 26. Cultivation of sweetpotatoes by "side-harrowing" with spring tooth cultivators.



Any major expansion in the sweetpotato acreage will make the problems of sweetpotato cultivation of maximum importance to the farmer. The necessity to transplant in more or less unfavorable soil conditions generally results in slow growth and poor stands, which in many instances call for an increase in hoe work. Under optimum conditions, a grower may use only 6 or 8 man-hours per acre in hand cultivation, while with poor stands and untimely cultivations, the result may be that hoe labor requirements are as high as 100 man-hours per acre.

Tractor cultivators. The general purpose tractor, with available cultivation attachments, meets many extreme service requirements of the sweetpotato grower. The variable speed possible is perhaps the

Figure 27. Cultivation of sweetpotatoes with small sweep on plow stock.



Figure 28. A large sweep attachment to a plow stock for cultivating sweetpotatoes.

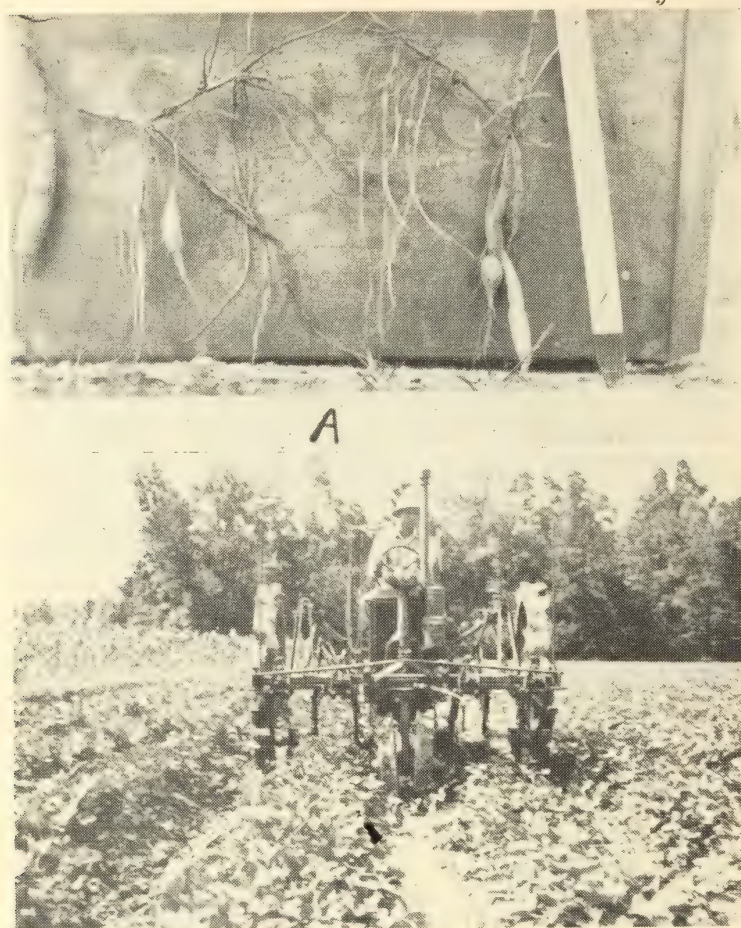


Figure 29. Small sweetpotatoes (A) produced on vines covered by late cultivation on moist soil (shown below).

greatest advantage of tractor cultivation. It is desirable to turn a great deal of soil into the row to smother out small weeds and grass in the drill, and the quantity of soil moved can be controlled by the speed of the tractor. It is believed that there is no ill effect from the covering of short vine sections in early cultivations, leaving only the bud of the plant showing. The results of covering long sections of vines with soil during cultivation are variable. When the soil is dry and remains dry for a few days after cultivation, it has been observed

that throwing considerable soil into the drill to kill weeds has no ill effects. In several cases, however, the covering of long vines with moist soil has resulted in a reduction in yield by late development of small sweetpotatoes on the covered vines. This is illustrated by figure 29. The small sweetpotatoes shown were produced on vines covered by the cultivation in wet soil shown in the same figure.

The relatively high ridged sweetpotato rows are the major handicap to a simple adaptation of standard tractor cultivation



Figure 30. Two-row tractor cultivator: A. First cultivation. B. Second cultivation. C. Third cultivation. (Fourth cultivation of this field shown in figure 29).

units. The units with pipe beam gangs are generally the easiest to shift from other crop cultivation to sweetpotato work. The more or less standard attach-

ments, consisting of disk hillers and many sizes of sweeps, enable the operator to obtain several distinctive results in cultivation as shown by figure 30.



Figure 31. Improper sweep attachment on a tractor cultivator.

The general procedure in setting up a tractor cultivator for sweetpotato work is largely by the trial and error method, starting with the tractor located on the job with the beams in the required working position. The soil-working equipment is then attached to the unit in such

locations along the row as will obtain the desired soil movement. Then, trial tests are used to indicate minor adjustments needed to obtain the desired soil movement or the proper weed control without vine injury.

The channel beam type cultivators have no cross angle adjustments, and as a result the soil working equipment cannot be fitted to the side of the bed. The shank fitted with a wide tool will work too deep adjacent to the row, while on the outside it will not be in contact with the soil (shown in figure 31). The absence of cross-angle adjustments with this type beam prohibits the use of many desirable standard tractor cultivator sweeps. However, good results can be obtained by using on the tractor cultivator sweeps designed for plow stocks.

The disk hiller has been used to obtain several distinct results in tractor cultivation. Frequently a thick stand of weeds develops soon after transplanting sweetpotatoes. In such a case, the disk hillers are set close in so as to bar-off the row and throw the weed growth



Figure 32. Cultivation of sweetpotatoes by bar-ring-off the rows with disk hillers.



Figure 33. Heel sweep attachment used on a one-row tractor cultivator for sweetpotato cultivation.



Figure 34. Cultivating sweetpotatoes with tractor equipped with gang disks on tool bar.

away from it, and 8- or 10-inch sweeps are attached in the rear of the disks, so as to plow fresh clean soil into the furrows and across the drill and thereby cover the weeds in the narrow band between the plants. This type of work is illustrated in figure 32. Disk hillers can be used in several locations on the cultivator to shift soil into the bed and to clean the middle. Generally, they are used in combination with sweeps of various types as shown in figure 31, or to obtain a special soil ridging movement, while the actual job of cutting off the weeds is done by the sweeps. The plow stock sweep unit shown in figure 28 has proved to be a satisfactory attachment for the one-row tractor, using one side of the cultivator only. This attachment is shown in figure 33.

Disk hillers and gang-bolt disk units as shown in figures 3 and 34 can be used to make high ridges during the process of cultivation as well as in seedbed preparation. The use of these gang disks for all of the cultivation operations for sweetpotatoes has not been successfully done. Information showing the value of several other special tractor attachments in sweetpotato cultivation is not available.

The number of cultivations required for sweetpotatoes will depend upon the rate of weed growth up to the time the vine growth covers the middles. Tests made of several cultivation operations after that period have shown no advantage, and the injury necessary in order to obtain a satisfactory soil movement that is unavoidable in obtaining has caused a reduction in yield.

Harvesting

Use of Crop Influences Methods

Problems of harvesting sweetpotatoes become more important as production becomes more extensive. Before efforts to industrialize sweetpotato production were begun, there was little need to work out efficient mechanical methods of harvesting. The acreage per farm was small, and the harvesting usually followed cotton picking and when there was an

abundance of farm labor. Commonly used methods of harvesting small acreages involve certain practices and tools which lower the quality of sweetpotatoes for the most critical buyer—the housewife. In a preliminary consideration of new outlets for sweetpotatoes it is advantageous to review some of the basic factors of harvesting which affect the marketable quality of the crop.

The appearance, hence the market value of table stock sweetpotatoes, is reduced by mechanical injuries. Success of keeping sweetpotatoes is likewise influenced, under many conditions of storage, by the extent and kind of mechanical injuries. Sweetpotatoes spoil after harvest, either in storage, or in transit, or on the market, chiefly because of soft rot and black rot, caused by specific organisms which are able to penetrate the broken, bruised skin of the root. The reason for sweetpotato curing is to speed up natural life processes in the roots, by the effects of high temperature and humidity of the surrounding air, so that rapid healing of wounds may take place. Bruised areas on sweetpotatoes are more difficult to heal than clean-cut surfaces. Gashes are equally undesirable. Injuries, therefore, should be kept to the minimum if the crop is not to be used within a few days.

Sweetpotatoes do not mature in the ordinary sense (growth is stopped by frost or drought) and may be harvested at different stages of their growth with varying results as to the amount of bruising that is likely to occur. If harvested while the sweetpotatoes are growing vigorously, the skins are tender and are easily bruised or broken by the harvesting implements, including tools and crates. If harvested later in the growing season (when, on account of the depletion of soil nutrients, lower temperatures and shorter daylight periods, the growth of the plants and roots is very slow), the surface of the roots will be found covered with a relatively tough skin. This toughness of the skin is reduced by increased soil moisture. Harvesting in soil which is “too

wet to plow" will result in more surface bruising than when the soil is just moist enough to prevent clodding. A soil in proper condition as to moisture is more important in mechanical digging than with any method of plow-digging. Soil that is in good moist condition and is not cloddy, forms a protection to the roots in harvesting. When the soil breaks up in large clods, excessive injury to the sweetpotatoes will result.

There are many causes for mechanical

injuries in the digging of sweetpotatoes. Cuts may be due to failure to control the depth of vine removal equipment, to too shallow adjustment of the digging blade, or to sweetpotatoes extending beyond the width of the digger. Some varieties of sweetpotatoes are especially adapted to digging operations because the roots are produced in a limited row area. Other varieties have such spread of root development that special equipment would be necessary for harvesting them



A



B

Figure 35. Harvesting problems in industrial utilization of sweetpotatoes illustrated: A. Long line of loads waiting for their turn to unload at the bins. B. Bins already running over.

without serious mechanical injuries. Bruises of sweetpotatoes are also associated with such actions as dropping or rough handling by the gatherers.

Harvesting Equipment

It is not intended to describe here methods of harvesting for the most exacting food markets; the work reported applies to sweetpotatoes as raw material for industrial use in certain new markets. These markets allow radical departures from the old concepts of sweetpotato utilization, especially with respect to grade requirement. Considerable time will be required to replace fixed customs and to work out satisfactory adjustments to industrial requirements. The first eight seasons of operation of the Laurel Starch Plant is a relatively short time to solve many problems of the farm and factory.

An industrial outlet for sweetpotatoes cannot be organized on a basis of convenience to the growers only. The Laurel Starch Plant, for example, can process

from 2,000 to 4,000 bushels of sweetpotatoes per day, and no more. This capacity divided among 400 to 1200 contracting growers allows very little liberty for individual action on any one day. It seems, therefore, that it is the combined responsibility of all the contracting growers to see that some sweetpotatoes are harvested early, and that the rate of delivery is as uniform as circumstances permit until the entire crop is processed. This period of harvesting may include days of intense heat and days of bitter cold winds. The soil condition may vary from very dry to muddy, or even may be frozen soil. An equitable distribution of the responsibility for a uniform rate of harvesting presents problems of farm and factory management which must be solved by any organization processing farm crops. With the exception of one crop season, the Laurel factory has purchased from its contractors on the basis of the old system of "first come, first served." This has been unsatisfactory, be-



Figure 36. Cooperative harvesting of sweetpotatoes by the employment of school children.

cause there have been periods when the factory operation had to be intermittent and manufacturing losses were excessive because of interruptions of the continuous process of making starch. There have also been periods when the grower accepted losses resulting from having his truck held up in a waiting line for days while the load of sweetpotatoes lost weight and spoilage started because of the development of soft rot (figure 35). A limited effort to regulate deliveries on a ratio of contracted acreage was made in the Laurel area in 1941. Many growers were reluctant to accept the forced regulation and presented various excuses for not cooperating. It is admitted that contracted acreage is not an exact basis for distribution of harvesting and delivery because an "intention to plant" is not necessarily a measure of actual planted acreage nor of actual production.

Limited experiments in 1942 indicated that growers will find it profitable to have their harvesting done by an efficient organization of field equipment, crew, and trucks under a centralized management. War restrictions on truck tires and other equipment have done much to show the advantage of an orderly system of cooperative or group harvesting. Figure 36 shows a group of school children at work in one field.

Usual practices. The usual method of harvesting sweetpotatoes requires many hand operations. When the acreage is small, the vines are cut with a hoe, scythe, or home-made sled type vine-cutter. If the vine growth is small, it may be rak-



Figure 37. Typical "heap-row."

ed into the middles to clear the row for digging; if the vine growth is large, it may be raked from the sweetpotato patch by hand, or with a plow or with a hay rake, with or without cutting. The digging usually is done by turning out alternate rows with several furrows of a small plow. The sweetpotatoes are collected from the plowed out rows and placed in a "heap-row," that is, in the center row

Table 6. Time required for removing sweetpotato vines before digging.

Method and equipment	No. cases studied	Man-hours required per acre		
		Maximum	Minimum	Average
Cut with hoe and pull to middles	6	64.0	10.6	24.2
Cut with hoe and roll to side of field	3	48.7	14.6	29.7
Cut with sled cutter and one mule	2	7.5	4.1	5.8
Rake sled cut vines to side with one mule and hay rake	1	—	—	3.5
Rake uncut vines to side with two mules and hay rake	1	—	—	6.3
Disking with two-mule unit	1	—	—	1.7
Dragging through vines with plow	4	—	—	3.5
Cutting with coulter on digging unit	many	—	—	0
Cutting with disk hillers	many	—	—	0

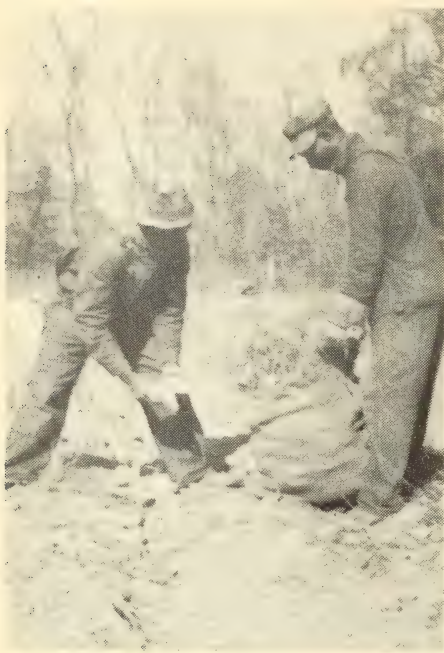


Figure 38. Filling bags from "heap-row."

of three adjacent rows. If the crop is to be sold to a starch factory, it is collected and loaded on a truck or wagon as a loose load, or is sacked and then loaded. If the crop is to be stored or sold for table use, a selected part is usually crated in the field. Figure 37 illustrates a typical "heap-row." Figure 38 shows bag filling from a "heap-row," using an extra man to hold the bag.

These methods in common use are very inefficient, time consuming, and expensive. Furthermore, they cause unnecessary injury to the crop. By referring to table 6, it can be seen that 24.2 man-hours are usually required to cut the vines on

an acre with a hoe and pull them to the middles, and if they are rolled to one side of the patch by hand, a total of 29.7 man-hours are required. Table 7 shows that the common method of plowing up the row with three furrows requires more than six man-hours per acre, and five man-hours per ton are required for collecting and heap-rowing after such digging.

Improved methods. The limited industrialization of the sweetpotato crop in the Laurel area has led to some changes in the local methods of harvesting. The most significant change has been in the general use of the rolling coulter shown in figure 39 for vine cutting on the 2-mule sizes of plows and middlebusters. This coulter has been found to be a satisfactory vine-cutter for starch sweetpotatoes. It is set well forward on the beam as illustrated and offset from the center when used on middlebusters. This setting and the use of an 8-inch coulter wheel results in very few sweetpotatoes being cut, provided the soil has been well ridged in cultivation. The coulter wheel must have a very sharp edge in order to cut sweetpotato vines on the relatively soft soil found on the ridges. No time factor is shown in the data in table 7 for use of the coulter. This is not exactly correct because experience has shown that it is advisable to file the coulter frequently in order to keep a sharp cutting edge. The elimination of hand methods of cutting vines and of the many furrows with small tillage tools has resulted in a saving of labor, as is shown by tables 6 and 7. The common practice of splitting the vine growth with a rolling coulter so that one implement op-

Table 7.—Time required to dig sweetpotatoes with different types of equipment.

Method or equipment	Average man-hours per acre
Plow and middlebuster, 2 mules	6.09
Middlebuster and coulter, 2 mules	2.03
Rod-wing middlebuster and coulter, 2 mules	1.82
Tractor attached rod-wing middlebuster and disk hillers	1.20
Tractor middlebuster, 1 row	1.50
Tractor, mechanical digger and disk hillers, 2 men	4.40
Tractor, mechanical digger without vine-cutters, 4 men	9.64

eration will up-root or dig the crop has resulted in a total loss of the feeding value of the vines, except in scattered instances where cattle are allowed to graze on them immediately before harvesting.

Experiments have shown that sweetpotato vine silage has a potential value as a farm feed, but an economical system of making vine silage has not been worked out. It would require harvesting the vines from several acres of sweetpotatoes in a relatively short time. In actual farm practice, the plan has not been tried in the Laurel area because growers have had no assurance as to the rate of harvesting. They are justified, therefore, in their reluctance to harvest vines early in the season, when there is a good chance that the root crop may increase in weight before the date of digging. A killing frost destroys the value of the vines, but a silage-making operation cannot be planned so that it will occur on the day preceding the frost.

Sweetpotato vine problems are of relatively minor importance when digging the Triumph variety as grown in the Laurel area for starch. This variety produces a moderately vigorous vine growth, which may partially die back in the early fall when there is a drought and the soil fertility is low. On fertile soil, however, and under good soil moisture conditions, this variety makes such vigorous vine growth as is illustrated by figure 40-A. Other varieties produce vines which are more vigorous, and with an early harvesting requirement, the removal of vines before digging presents real problems. The Porto Rico variety grown extensively for food is usually a more vigorous grower than the Triumph, as is shown by figure 40-B. Such sweetpotatoes grown in large acreages will give an opportunity for the development of methods and equipment for harvesting the vines for farm feed and for industrial utilization.

Digging sweetpotatoes consists of up-rooting the row so that the roots can be seen and gathered with a minimum of effort and crop losses. The objective in

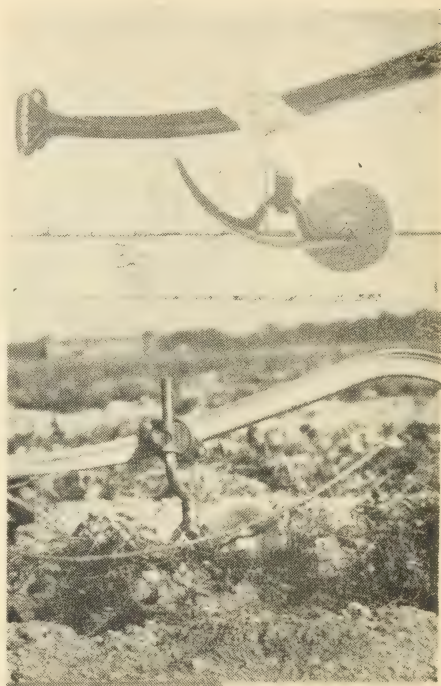


Figure 39. The shielded roiling coulter attached for cutting sweetpotato vines.

digging the starch varieties for factory utilization is to harvest the crop at the lowest possible cost. Cuts, bruises, or breaks do not significantly reduce the market value, so long as there is no delay in getting the roots processed. The objective in digging sweetpotatoes for almost all other uses than making starch is to have a product with a minimum of mechanical injuries. Sweetpotatoes intended for storage or delayed use must be handled with special care. Hence, many of the rough methods of handling reported on in the following pages are applicable to starch sweetpotatoes only, and are not applicable under many conditions for the food crop where appearance and storing qualities are of major importance.

The labor requirements for digging sweetpotatoes with different types of equipment are given in table 7. There is considerable difference in man-hours required by the use of different imple-



Figure 40-A. Vigorous vine growth of sweetpotatoes: Triumph variety.

ments and combinations of implements. The first method shown in the table is a slight improvement over the method previously described as commonly used in the Laurel area. The barring-off of the row with a plow, eliminates part of the soil that must be handled by the middlebuster in the digging operation, but considerably increases the total labor requirement. Some growers use a large plow to partly invert the barred-off row, but generally a one-horse plow is used.

Standard middlebusters. The effectiveness of the standard middlebuster as a sweetpotato digger in a single operation to the row is largely dependent upon the size of the buster and the conditions of its use. In many soil conditions, the middlebuster turns up two well-pulverized furrows which drop away and leave the sweetpotatoes in a condition for easy collecting, as shown in figure 41. With a 12-inch blackland type middlebuster, the

speed of operation influences the percentage of crop loss under typical conditions of gathering. Experiments showed these losses to be 16.9 percent at 1.5 miles per hour, 30.1 percent at 3.0 miles per hour, and 38.0 percent at 5.2 miles per hour. An extra tillage operation is usually required to uncover sweetpotatoes covered by furrows made at high speed. Narrow or small-sized middlebusters often fail to uproot a large percentage of the crop when produced in wide hills, and should not be used.

The direct attached single-row tractor middlebuster is an improvement over the mule-drawn implement in digging sweetpotatoes, especially where there is a rank growth of weeds and grass. Frequently the tractor middlebuster is used incorrectly, by running it too deep and too fast, thereby resulting in high crop losses. The 2-row tractor middlebuster unit as shown in figure 41-B causes excessive crop losses in the deep and overlapping center furrows. Generally, the standard coulters



Figure 40-B. Vigorous vine growth of sweetpotatoes: Porto Rico. (Unit 1) variety.



Figure 41. Middlebusters. A. A common mule-drawn type. B. Double middlebuster, tractor attached.

attachment for tractor middlebusters cannot be adjusted to eliminate excessive cutting of the sweetpotatoes, because they are not equipped with a shield and are too

large in diameter. In the regular beam type middlebuster, the shielded coulter shown in figure 39 can be used. Disk hillers may also be used in an arrange-

Table 8.—Percentage of crop losses following middlebuster and rod-wing middlebuster digging with common methods of gathering sweetpotatoes.

Implement used	1938		1939		1941	
	No. of tests	Percent crop loss	No. of tests	Percent crop loss	No. of tests	Percent crop loss
Regular two-mule middlebuster	3	11.1	19	17.6	95	19.5
Rod-wing middlebuster	4	7.6	5	3.8	117	12.5

Table 9.—Time required to collect and heap-row sweetpotatoes after different methods of digging.

Method and equipment	No. of cases studied	Man-hours required per ton		
		Maximum	Minimum	Average
1. Two furrows with plow and one furrow with middlebuster	12	6.62	2.04	4.71
2. Middlebuster with coulter	24	9.40	1.40	4.39
3. Rod-wing middlebuster with coulter	13	4.84	1.29	2.75
4. Tractor middlebuster with coulter	—	—	—	—
5. Mechanical digger and disk hillers	5	2.34	1.56	1.86

Table 10.—Time required to sack sweetpotatoes from heap-row after different methods of digging.

Method and equipment	No. of cases studied	Man-hours required per ton		
		Maximum	Minimum	Average
1. Plow and middlebuster	14	7.28	1.86	3.46
2. Middlebuster	12	6.44	1.04	3.16
3. Rod-wing middlebuster	7	2.44	1.01	2.26
4. Tractor middlebuster	—	—	—	—
5. Mechanical digger	5	2.98	1.36	1.88

Table 11.—Time required to collect, heap-row, and sack sweetpotatoes after different methods of digging.

Method and equipment	No. of cases studied	Man-hours required per ton		
		Maximum	Minimum	Average
1. Plow and middlebuster	17	28.32	3.08	10.15
2. Middlebuster	67	20.8	2.44	9.10
3. Rod-wing middlebuster	12	7.28	2.30	5.01
4. Tractor middlebuster	5	—	—	5.66
5. Mechanical digger	5	3.96	1.56	3.22

ment discussed in connection with mechanical diggers, to cut the vines simultaneously with digging by the attached middlebuster.

Tables 7, 9, 10, and 11 present data which show the efficiency of digging sweetpotatoes with standard middlebusters. Table 7 shows that 2.03 man-hours per acre were required for digging with a 2-mule middlebuster with coulter attached, or one-third as much as is required by the three-trips-per-row methods in common use. These data show that only 1.5 man-hours are required for the one-row tractor middlebuster. In table 9, the data show an average of 4.39 man-hours per ton for collecting and heap-rowing after middlebuster digging, which is not significantly less than that required after three-furrow digging. Table 10

shows that sacking heap-rowed sweetpotatoes behind middlebuster digging requires about as much time as does that behind the three-furrow method. The total time for collecting, heap-rowing, and sacking is shown by table 11 to be approximately the same, only one hour less, for middlebuster digging as for three-furrow digging.

Experimental middlebusters. A series of sweetpotato digging experiments was conducted to find methods whereby the work of the regular plow or middlebuster could be improved. The relatively wide distribution of the sweetpotatoes in a hill requires the movement of a large volume of soil to prevent losses and excessive cuts. Hence, implements of the so-called 2-horse size are the minimum requirements in capacity. A reduction

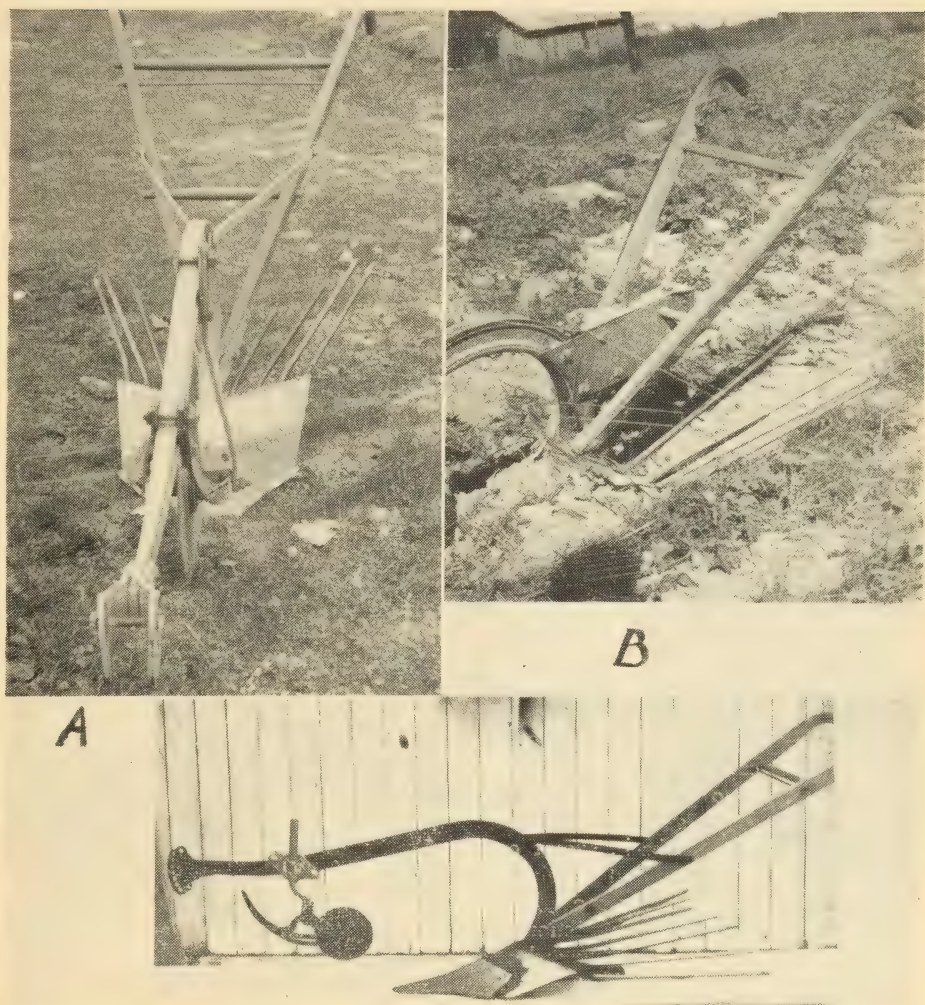


Figure 42. Rod-wing middlebusters. A. Original model (photo by T. N. Jones). B. One of the grower made models. Bottom, Jones' 1941 model.

in the length of the moldboards on a regular, "turning" plow or middlebuster may increase the proportion of the crop exposed to view for gathering, but only under limited conditions.

The rod-wing attachments to the 2-mule and tractor middlebusters have been used in many forms in the Laurel area. The first development made by Anderson and Jones in 1937, illustrated in figure 42-A, had the rod-wings starting about half-way the height of the regular

middlebuster. In later developments as shown in figure 42-C, the point of attachment has been lowered to a line close to the back of the share. The typical 12-inch middlebuster share has been made into or replaced by a 16- or 18-inch share in order to give the unit a greater capacity. Details of construction are shown in figure 43-A, and the rod-wing attachment construction is largely a job of cutting, welding, and grinding. The plan of construction of the tractor

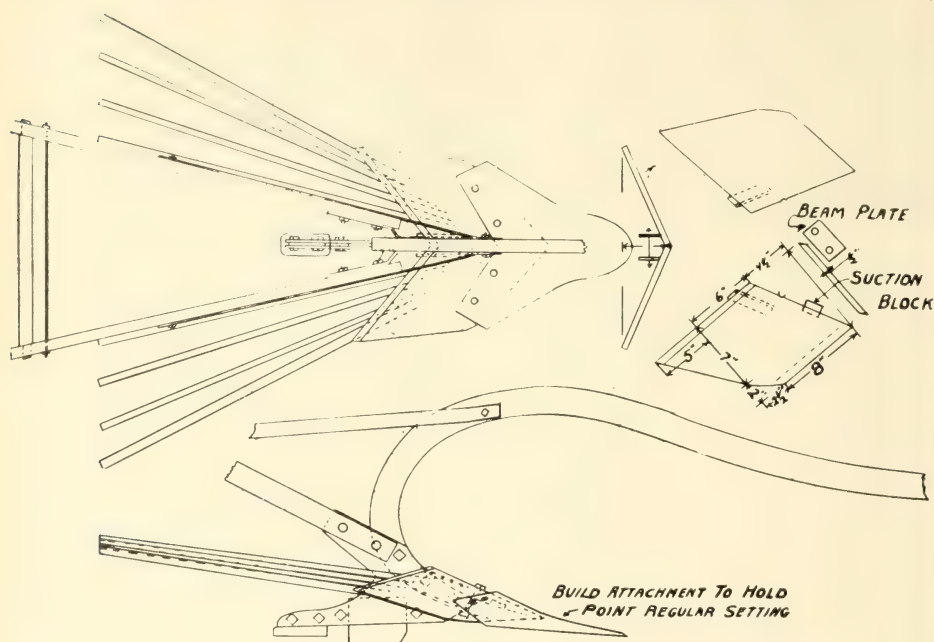


Figure 43-A. Rod-wing middlebuster: Mule unit attachment.

rod-wing attachment is shown by the drawings in figure 43-B and the pictures in figure 44. It consists first of backing up the share with two layers of metal. The top layer extends the surface of the share for about three inches back, except over the frog which it covers and to which it is bolted. This surface part of the attachment may be made up in sections for easy construction, and later welded and smoothed by grinding. Half of the lower plate on the inner end is fitted close to the frog, the back edge lines up with the top plate, and the lower or forward edge extends below the share for a sufficient distance to allow attachment with the regular share and moldboard bolts. The upper and lower plates are welded on the back edge and through holes drilled into the lower plates. Care in this construction will give an attachment which will not damage the regular middlebuster, when the standard share and moldboards are again installed.

It must be remembered that different models of commercial middlebusters vary in design of construction, and hence the

rod attachment must accordingly be varied in design. The rod-wings are made of soft iron rods $\frac{5}{8}$ - to $\frac{3}{4}$ -inch in diameter, welded to the special attachment plate in a fan pattern. The length and number of rods have been varied in different test units, but 8 rods will usually be sufficient. A few short rods with little soil sifting action will not uncover and expose as many sweetpotatoes as several long rods. The added soil sifting increases the amount of skin abrasions on the sweetpotatoes, however. Figure 45 shows a mule drawn rod-wing middlebuster at work and typical exposure of sweetpotatoes by the use of this type of digger. The work of typical tractor rod-wing attachments is shown by figure 46.

The one-point attachment of the rod-wings, as shown in figure 44, allows many field adjustments by bending the rods to obtain the desired result in digging. The rods may be bent out in a wide fantail shape in order to expose all the sweetpotatoes or closed in and bent down so that they will run under the

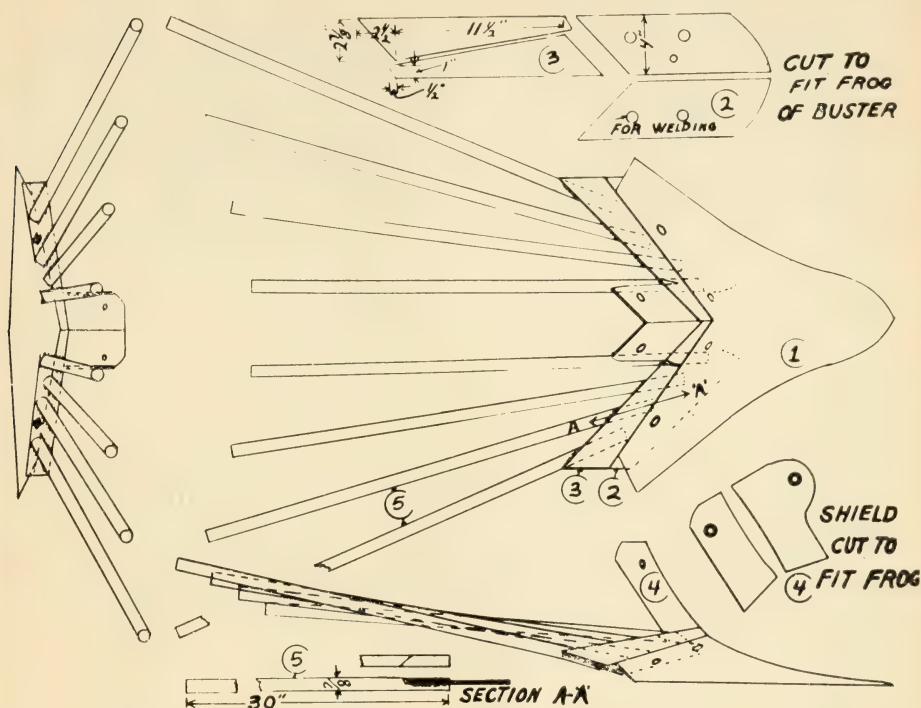


Figure 43-B. Rod-wing middlebuster: Attachment for tractor beams.

crop and give a partial exposure within or close to the row.

The proportion of the crop that is placed in full view by these diggers depends upon such factors as variety, yield, speed of operation, and angle and spacing of the rods. The angle and speed of operation can be varied in the field to obtain the most exposure under the conditions of digging. Generally, the faster the operation of this type digger, the better will it expose the sweetpotatoes. In table 7 the data show that 1.82 man-hours per acre are required to dig with the mule drawn, and 1.20 man-hours per acre with the tractor attached rod-wing middlebusters. These figures are very much lower than those for the three-furrow plowing method. Table 11 shows that these diggers have a labor requirement for heap-rowing and sacking of only 5.01 man-hours per ton, or half as much for this work as after digging with the three-

furrow method. Table 8 shows data on the percentage of crop losses following digging with rod-wing and common middlebusters. These data vary from year to year because of the differing conditions under which the observations were made, but considerable advantage is shown in all cases for the rod-wing type of implement.

Commercial plow type diggers. In the investigations of plow and middlebuster diggers, several commercial implements sold for digging Irish potatoes were tested, and were found to have no special merits as sweetpotato diggers. Various views of the units tried are shown in figure 47. These diggers do not have the strength nor the capacity necessary to handle a row of sweetpotatoes. The vine-cutting equipment, where furnished, would not satisfactorily cut the vines.

Vibrating rod diggers. One commercial digger with a vibrating rod attach-

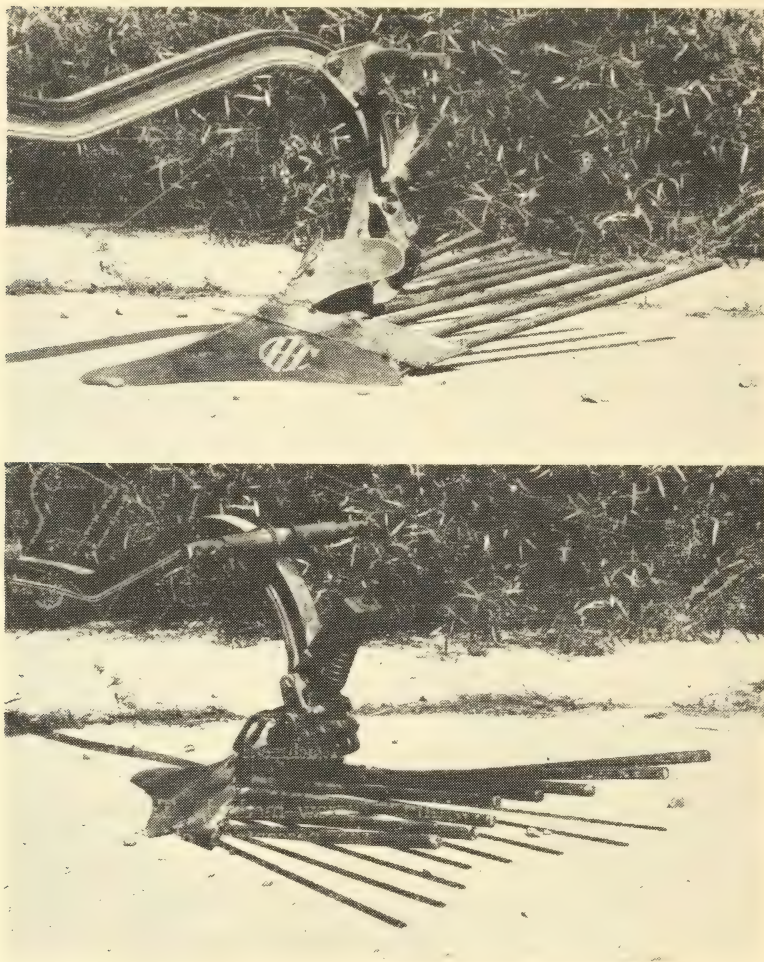


Figure 44. Views of a tractor rod-wing attachment.

ment was tried, and was found satisfactory for digging sweetpotatoes in light sandy soil where the crop was produced near the surface. This unit is shown in figure 48. For digging sweetpotatoes with this unit, the depth gauge wheels and the vine kicker on the beam must be removed, and if the vines are to be cut simultaneously, a shielded rolling coulter attached as with middlebusters. Tests of this unit showed that it does not have sufficient capacity for digging Triumph sweetpotatoes under typical conditions of the Laurel area.

The limited success of digging sweet-

potatoes with this commercial vibrating rod unit suggested the construction of an experimental vibrating rod-wing middlebuster digger. This unit, shown in figure 49, attached to a tractor, was provided with sufficient power application to cause the necessary vibration of the rods. A comparison of work of this unit with the rigid rod-wing units showed no special advantage of the added mechanism.

Experimental Plow-type Diggers

It has already been pointed out that the harvesting of sweetpotatoes for storage requires a minimum of mechanical



Figure 45-A. Work of various models of rod-wing middlebusters: Mule drawn unit.

injuries. One of the disadvantages of the use of middlebuster diggers is that they cause considerable bruising, skinning, and cutting of the sweetpotatoes because they divide the hills, usually in the center. When a rolling coulter is used on a middlebuster for cutting vines, many roots of wide hills are cut in spite of the offset adjustment recommended for the coulter. On account of the possibility of these injuries, the middlebuster type of digger is not recommended for harvesting sweetpotatoes which are to be stored. Experiments have shown that some form of broad base turning plow is the best equipment for this harvesting. Studies have been made of several types of adaptations of plows in an effort to obtain information about the efficiency and success of their use.

Walking plows. Observation has shown that very few plowmen can adjust and hold a broad base walking plow on a sweetpotato row in such a way that it turns over the sweetpotato hills, exposing them for gathering, without mechanical injuries. This is true because the plow must be operated, for single-trip digging,

with the landside so far to the side of the ridge that it cannot obtain a footing necessary to offset the plow's side forces. Many growers do not have plows that are large enough to turn out sweetpotatoes at one

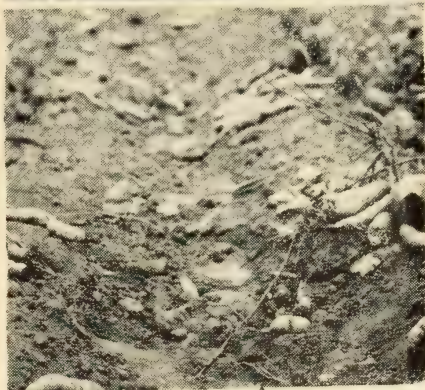


Figure 45-B. Work of various models of rod-wing middlebusters: Typical exposure of sweetpotatoes by rod-wing units when properly adjusted.



Figure 46. Tractor attached rod-wing middlebuster diggers.

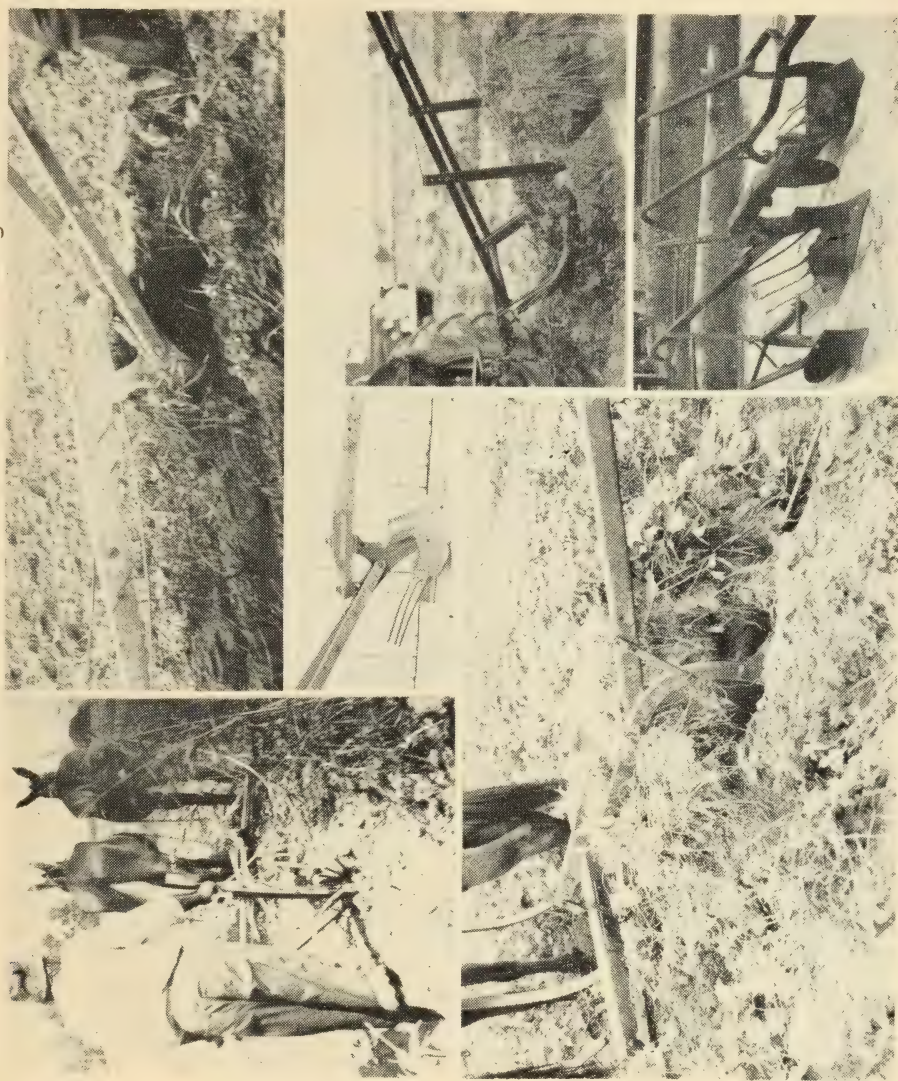


Figure 47. Commercial potato diggers tested in sweetpotato digging.

furrow to the row. If this equipment cannot be obtained, it is recommended that table stock or other storage sweetpotatoes be dug by using the largest plow at hand, so as to bar-off one side of the row at one trip, turning over the hills of sweetpotatoes at the second trip. A rolling coultter, adjusted shallow, can be used for cutting the vines and the first or barring-off furrow should be run far

enough to the side of the row that no injury will be done to the hills of sweetpotatoes. Digging by these walking plows would be improved if the standard 10- or 12-inch shares are either replaced by 14- or 16-inch shares, or made wider by welding extensions on the wings of the shares.

Tractor plows. In studies made in the Laurel area, it was found that best re-

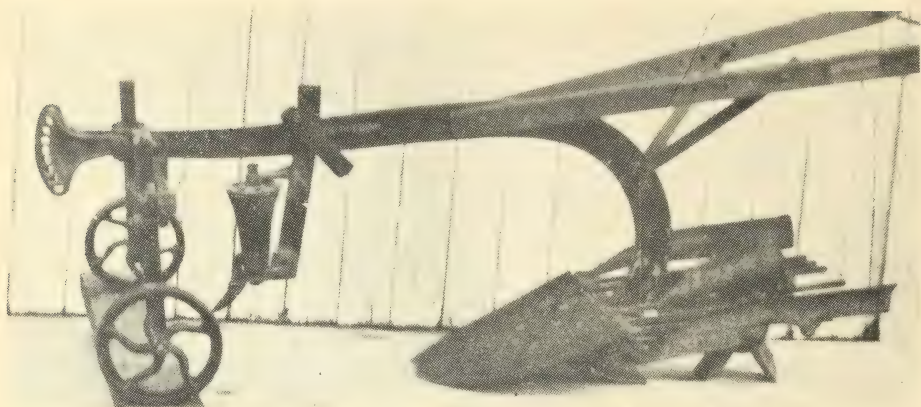


Figure 48. A commercial potato digger with vibrating rods.

sults could be obtained by digging with broad base tractor plows. One plow tried is the standard two-way unit shown in figure 50. For digging sweetpotatoes the right- and left-hand 16-inch bottoms of this plow were attached about 5 inches nearer to the center of the tractor than in its standard setting for land breaking. Also, it was necessary to adjust the width of the tractor rear wheels to approximately 80 inches from center to center. Because the plows were operated on the edge of the ridged rows, they had to be

shackled to the tractor in such a way that the side forces could be offset; but this resulted in the plows being hard to control because each minor movement of the front end of the tractor shifted the plow bottom. A side shifting of the plows as little as 2 inches affected the quality of digging, a disadvantage especially noted when digging in curved rows and on hillsides. In order to correct these difficulties, the manufacturer of this plow designed a special rolling coulter for attachment to the landside. This coulter, shown in figure 51, follows in the furrow and holds the bottom as accurately on the row as if the landside were operating against a soil bank. This attachment greatly improves the adaptability of the tractor plow for digging.



Figure 49. An experimental vibrating rod-wing attachment for a tractor middlebuster.

Best results are obtained with the two-way tractor plow when operated so that the shin of the plow is about eight inches from the center of the row, causing the share to cut under the middle of the sweetpotato hills. This adjustment, with slow speed of operation, turns the row on edge with a slight buckling action which cracks open the bottom of the furrow slice. This action of soil movement is so gradual that the hills of sweetpotatoes usually remain attached to the crown, but the bottoms of the hills are exposed for easy finding. The quality of digging with this plow is indicated by



Figure 50. Two-way tractor plow used for digging sweetpotatoes.



Figure 51. Direct attached two-way tractor plow with special rolling coulter landside attachments.

figure 52, which shows the typical exposure of sweetpotatoes. The two-way plow has a special advantage in harvest-

ing in that by the use of both bottoms all the rows can be turned in the same direction.



Figure 52. Typical exposure of sweetpotatoes dug with a two-way tractor plow.

Another tractor attached plow adaptation for satisfactory sweetpotato digging is shown in figure 53. This unit was

developed by removing the bottom from the standard one-row tractor attached middlebuster and attaching a 16-inch

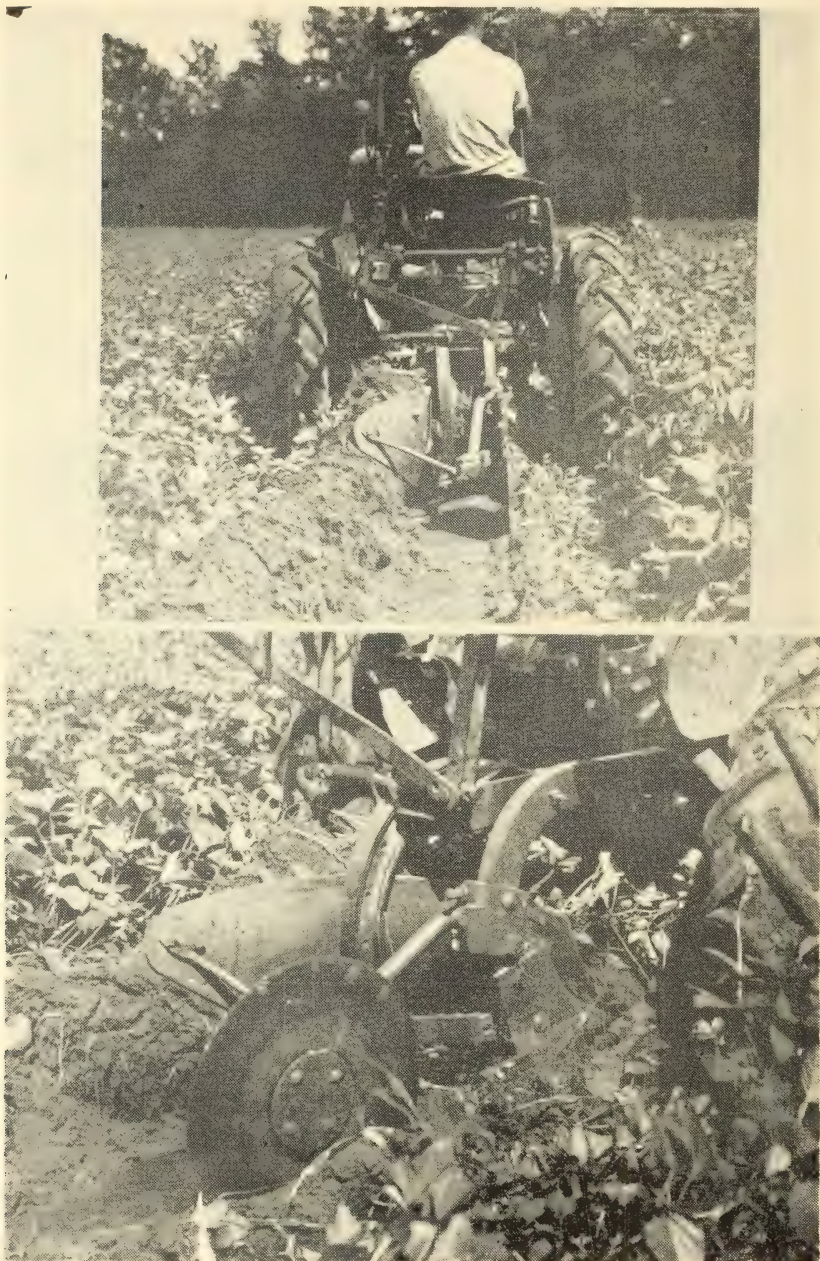


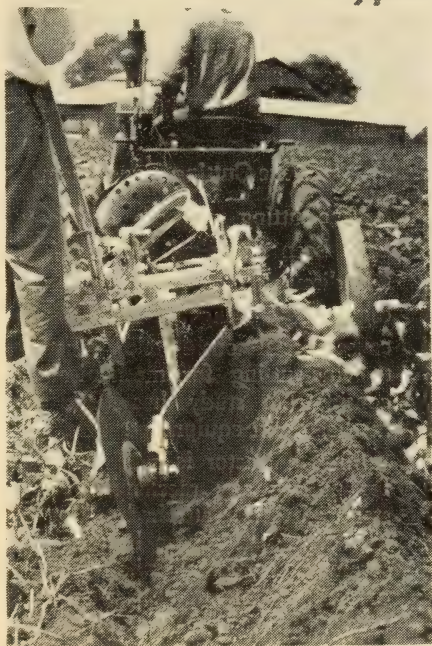
Figure 53. Sixteen-inch plow bottom attached off-center on middlebuster beam of a one-row tractor.

plow bottom. This plow bottom is attached off-center as shown in the figure, so that it can be operated properly on the side of the row while the tractor is

driven evenly astride the row. Because the plow bottom is attached to the middlebuster beam, it is readily adjusted and controlled by the standard lever



A



B



C

Figure 54. A tractor drawn 18-inch plow adapted for sweetpotato digging. A. Side view. B. Rear view. C. Drawing of sulky plow adaptation.

equipment, located conveniently to the driver.

When available, the standard commercial one-row tractor-attached broad base

plow is also suitable for satisfactory sweetpotato digging, provided the proper modification of the assembly is done. As designed, this plow is assembled so that

it is set off-center with respect to the tractor. This is necessary so that in breaking land, the tractor wheels can follow in the furrow. In changing the assembly for use of the plow as a sweetpotato digger, in most cases it is possible to change the attachment links or make other attachment bars for offsetting the plow bottom considerably to the side. If necessary, the tractor could be driven slightly off the row center in order to operate the plow properly under the hills of sweetpotatoes. The necessary modification of assembly and adjustment, of course, will vary with the type of tractor and equipment available.

Tractor drawn sulky plows may also be used for digging sweetpotatoes. These plows as usually designed, however, require considerable modification, and are not recommended except for use by large growers who can afford to make the necessary expenditures for changing the design of the plow.

Figure 54 illustrates one sulky plow which was modified for experimental use in digging sweetpotatoes. As shown, the 18-inch bottom in this unit is attached to an extra plow beam, which is mounted in the original frame in such a way that it can be adjusted horizontally. This is accomplished by the use of a vertically placed lever at the rear. This adjustment is advantageous because it provides for the plow being kept in operation in the proper location on the row. It is necessary for the control of this plow also to provide a rolling coultter to run in the furrow, similar to that described for tractor-attached plows. In the sulky plow, however, a frame must be made for the coultter attachment. In the experimental unit shown in figure 54, a seat was attached to the coultter frame, and if a man rides this seat, he can keep the plow properly adjusted in the row, removing that responsibility from the tractor driver.

In digging sweetpotatoes with tractor plows, whether the attached or sulky type, it is convenient to cut the vines at the

same operation. This is done with a small rolling coultter or a single disk hiller attached on the cultivator frame in front and far enough to the side that no sweetpotatoes are cut. Since the plow landside is operated far to one side of the ridge, the vine-cutter may be set so that it cuts the vines near the bottom of the row middle. This adjustment will insure that no sweetpotatoes are cut, and actually improves the vine-cutting operation, because the soil is more compact in the middles than on the ridges. The vines cut in this way are easily turned over with the plow furrow slice. When a sulky plow is used, the vine-cutting coultter may be attached to the plow frame as shown in figure 54; but the attachment to the tractor cultivator frame is more satisfactory because this provides for easy and quick adjustment of the coultter, independently of the plow operation.

Vine-Cutting Experiments

Vine-cutting methods and equipment have been described in connection with the discussion of the various plow-type diggers, including the middlebusters. Because special consideration must be given to vine-cutting for mechanical digging, considerable study has been made of methods and equipment.

Since a tractor is considered necessary for pulling any mechanical digger, the standard tractor attached cultivator frame has been used as the base for attaching several experimental units for vine-cutting or removal. Most of these studies have been with the type of one-row tractor on which it is possible to use the front section only of the cultivator and thus not interfere with the regular drawbar hitch. There is an advantage in having the vine-cutting operation in front and in clear view of the tractor driver, thus to enable necessary adjustments to insure proper cutting. Standard commercial disk hillers have been tried in many adjustments and attachments for cutting the vines or completely plowing them off the row,

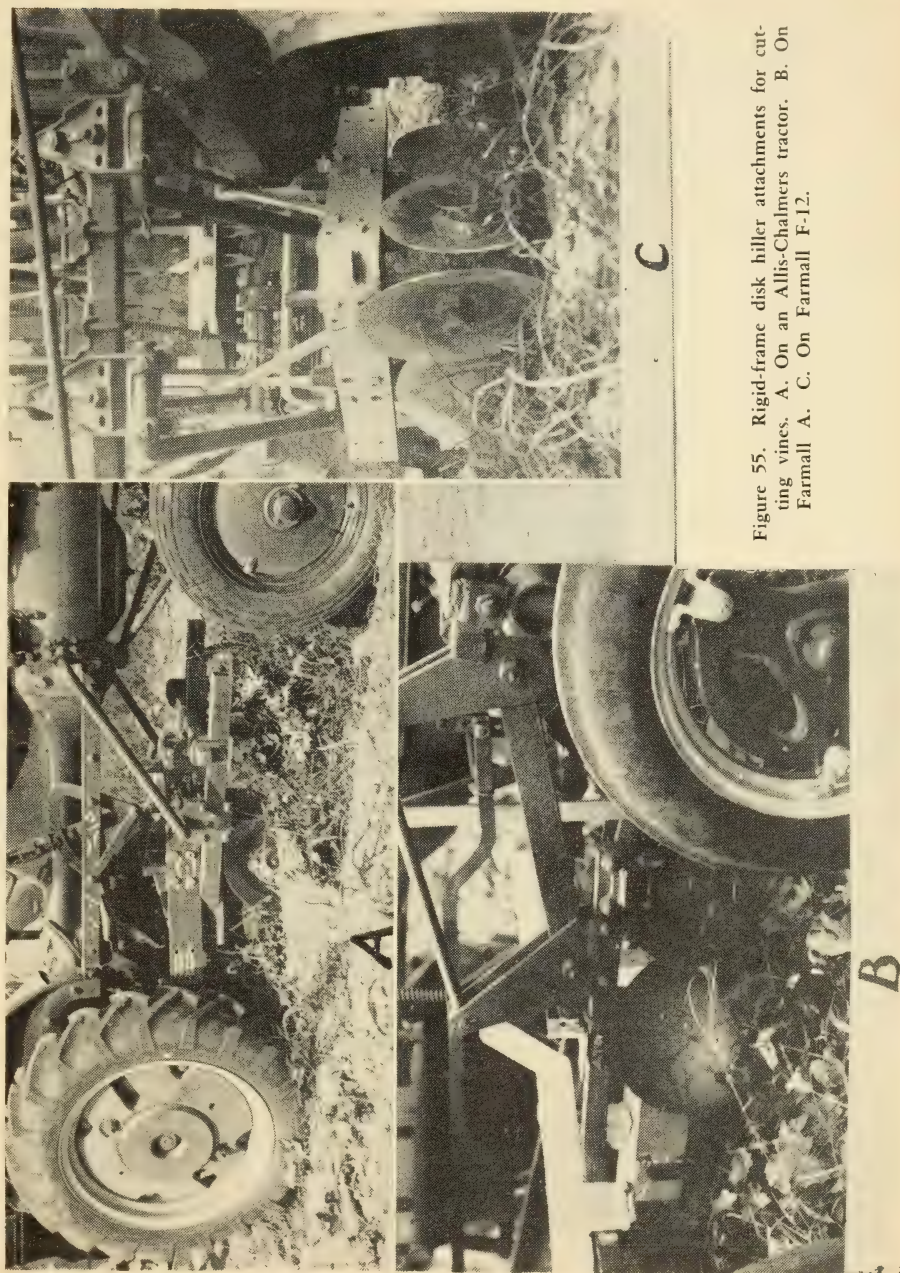


Figure 55. Rigid-frame disk hiller attachments for cutting vines. A. On an Allis-Chalmers tractor. B. On Farmall A. C. On Farmall F-12.

simultaneously with the digging operation. The wide limitations on mechanical injuries to sweetpotatoes used for starch make it permissible to push most

of the vine growth into the middles.

Rigid frame disk hillers. The experimental disk hiller units shown in figure 55, made to cut the vines from the row

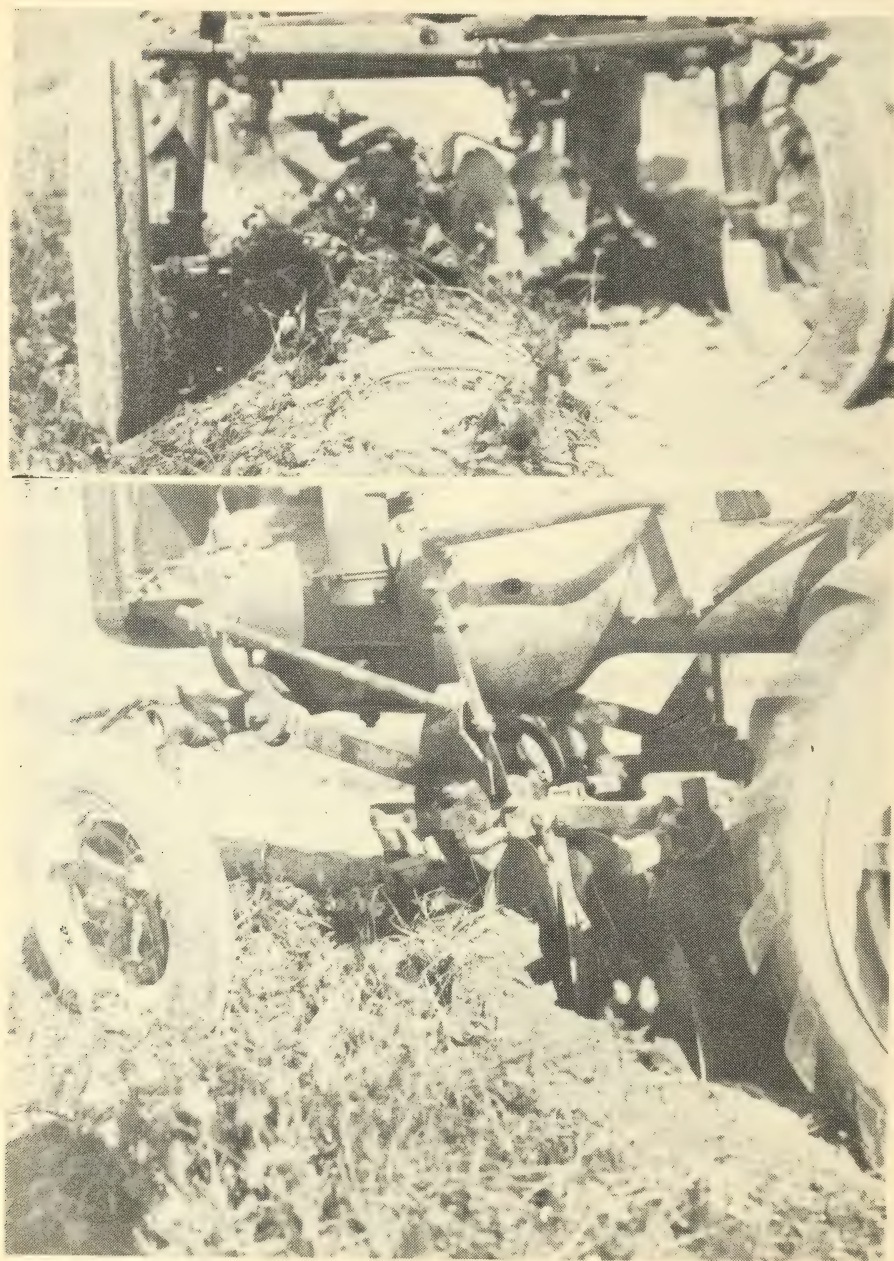


Figure 56. Disk hiller attachment on one-row tractor cultivator for cutting vines from center of the row.

in a fixed pattern, are attached in a rigid frame. Although this type of unit will remove the vines satisfactorily under

many field conditions, it is often impractical because of excessive disk breakage when operated on rigid frames. For that



Figure 57. Disk hiller attachment on tractor cultivator set to remove vines and part of soil.
A. From high ridge rows. B. From low ridge rows.

reason, it is advantageous to use the type of cultivator which allows flexibility in operation.

Adjustable cultivator disk hillers. Figure 56 illustrates one of the simplest arrangements of disk hillers tested. Here, the off-center shank disk hillers are set for operation so that the vines are cut and pushed from the center of the row. Three pairs of disk hillers, set in a "v" underlapping arrangement, can be adjusted for obtaining many different results of vine-cutting. Figure 57-A shows

one result of the use of this type of equipment adjusted for moving a considerable amount of the soil along with the vines from over the sweetpotatoes on high-ridge rows, and figure 57-B shows the work of this same unit on low-ridge rows. If a disk hiller attachment is used for cutting vines for digging table stock sweetpotatoes with a mechanical digger, the center-row hillers should not be used. The unit, then, will have two pairs of hillers as shown in figure 58, and will cut the vines along the sides of the row,



Figure 58. Disk hiller attachment on a special tractor frame set for cutting only the edges of the row.

as illustrated by figure 59-A. When thus operated, a narrow mat of vines is allowed to pass through the digger, and is draped over the row as shown by figure 59-B. In accomplishing this type of work, the digger operator may have to watch carefully to keep the mat of vines moving through the machine. This surface mat of vines on the dug sweetpotatoes, however, causes delay in the work of gathering the sweetpotatoes.

Certain types of horizontal blade vine-cutters have been tried, with varying degrees of success. In general, this kind of cutter either does not cut sweetpotato vines clean enough for mechanical digging, or the cutting is done in the wrong place on the row. Generally, these blades may cut vines for a distance but soon choke down, making a stop of the digging equipment necessary. One of the experimental blade units tried in these studies is shown in figure 60.*

*/This unit was designed by W. M. Hurst, Senior Agricultural Engineer, Division of Agricultural Engineering, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture.

Mechanical Diggers

The commercial rod-link-chain mechanical digger has been developed and improved during many years of use in harvesting Irish potatoes. There are several different types, models and designs, each adapted for some special commercial area, condition, or grower requirements. Because of the success of these machines in digging Irish potatoes, an extensive study was made of their adaptability to digging sweetpotatoes.

The problems of digging sweetpotatoes, however, are unlike those of digging Irish potatoes. The plant growth of a typical Irish potato field at harvest time is small as compared to that of a sweetpotato field. Irish potato plants do not trail, and hence offer no problems of tangling and clogging in the machine. Simple deflecting rods or kickers may be used to by-pass the vines from the row of dug Irish potatoes. Even in cases of extreme plant growth a simple arrangement of coulters in front of the digger blades prepares the row for machine digging. Irish potatoes are produced in a relatively narrow row area, near the surface of the soil; and since only a shallow depth of digging is necessary, the soil handled will usually pulverize and sift through the chain readily. Sweetpotatoes are not only characterized by having trailing vines which are tangled across the rows, frequently offering the resistance of a mat of rope, but the hills may extend to a depth of 8 to 12 inches and to the center of the row middles, depending upon production factors. Often sweetpotatoes may extend below the normal depth of plowing and in order to avoid cutting off the long ones, it is necessary for a mechanical digger to plow up subsoil or a distinct plow sole. Most standard mechanical diggers are not designed for deep or subsoil plowing. Figure 61 shows an extreme case of root development, where the spread of a Triumph hill in a low ridge on fertile soil extended nearly a yard in width. This indicates the extreme

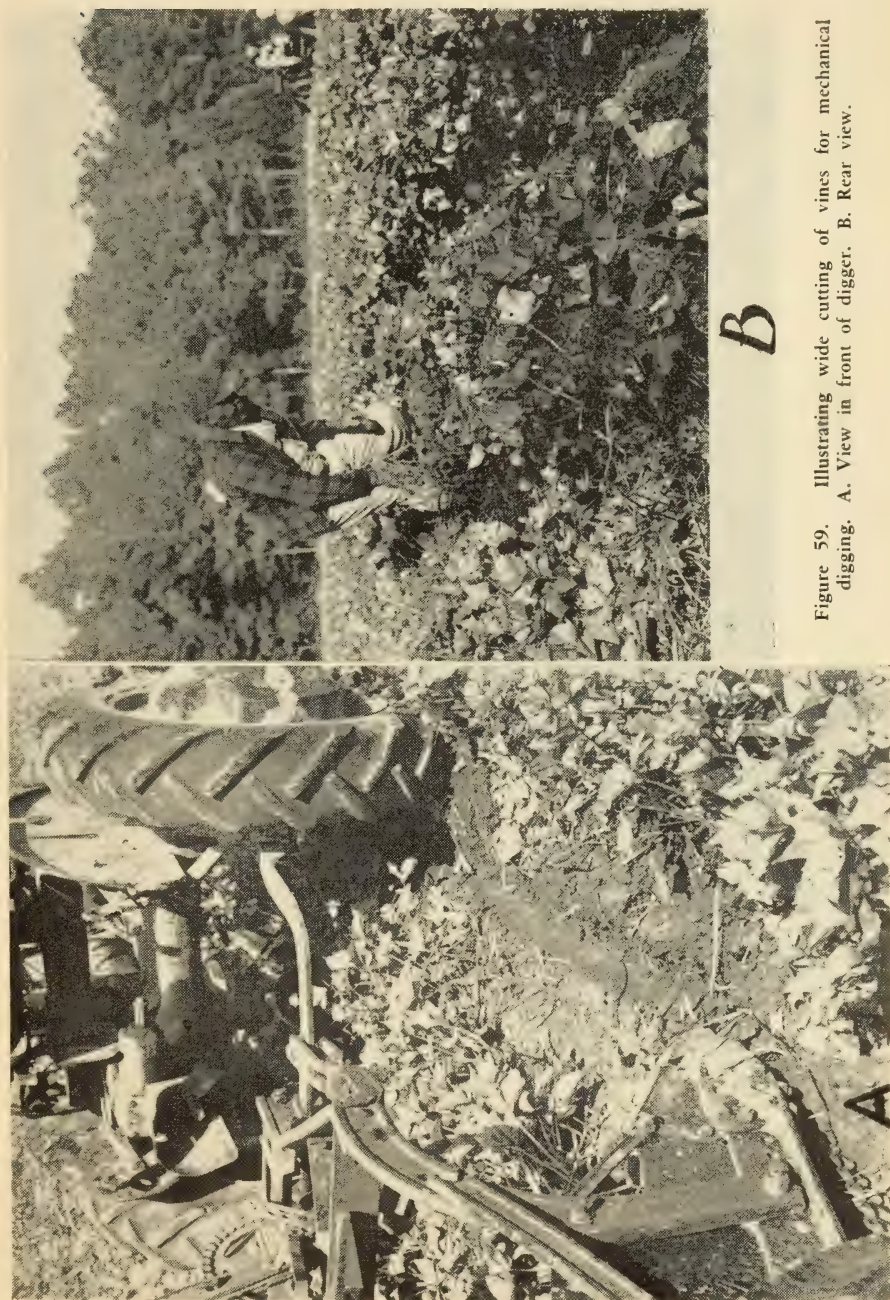


Figure 59. Illustrating wide cutting of vines for mechanical digging. A. View in front of digger. B. Rear view.

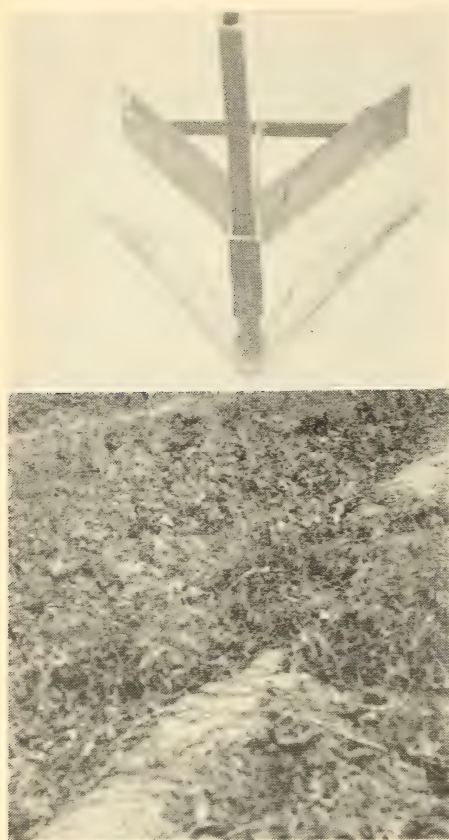


Figure 60. Knives used to cut sweetpotato vines, and a sample of the work done.

requirements that may be placed on a mechanical digger in sweetpotato harvesting.

Commercial mechanical diggers. Two forms of commercial mechanical Irish potato diggers have been tried in these investigations, the oscillating bar type and the rod-link-chain type. Figure 62 shows the oscillating bar digger. The design of this digger provides for the separation of soil from potatoes by a sifting action obtained by power transmitted from the digger wheels through sprockets and chains. This unit was unsatisfactory for digging Triumph sweetpotatoes under the deep and variable soil conditions encountered in the Laurel area.

The rod-link-chain type of digger is manufactured on two different basic designs, the level-bed and the elevator. The level-bed type has been developed for use primarily in harvesting Irish potatoes with a minimum of mechanical injuries, on the theory that the less elevating accomplished in digging potatoes, the less will be the injury that is likely to occur.

Figure 63 illustrates three models of level-bed mechanical diggers tried in these studies. Each of these models is operated by the power take-off from the tractor, but they can be equipped with attached engines for power. The latter arrangement is the more desirable of the two designs because of the flexibility and greater range of chain speed made possible by having an independent source of power.

Figure 64 illustrates two commercial elevator-type potato diggers which were used in these studies. Each is equipped with a gasoline engine for power to operate the chains.

Much work was done in these investigations in efforts to adapt the standard Irish potato mechanical diggers to the digging of sweetpotatoes. The types and models described above were tried under various soil and crop conditions, and an evaluation made of their efficiency as compared to plow types of diggers. Certain changes in design were found necessary, and many operating techniques were developed, making it possible under specified conditions satisfactorily to harvest sweetpotatoes with mechanical diggers.

Adaptation of mechanical diggers for sweetpotato harvesting. One effort to adapt the rod-link-chain elevator digger to sweetpotato digging resulted in the design and building of the experimental direct attached tractor unit shown in figure 65. The work with this unit was made possible by the cooperation of a larger grower in the Laurel area, Mr. Lee Graves, who furnished the tractor and certain of the materials and equipment necessary to construct and test the digger. The use of open-gearing, a truck trans-



Figure 61. Cross-section of a sweetpotato hill showing nearly 3-foot spread of roots.

mission, and other used automobile parts in making this assembly was quite satisfactory from the standpoint of efficiency of operation. The arrangement of a draft load on one side of the tractor and a torque driving load on the opposite side sufficiently balanced the tractor that there was no difficulty in steering or controlling the entire machine. A direct-attached digger should be of special value to those who grow large acreages with a limited supply of labor. Mr. Graves used this experimental unit to harvest a 30-acre crop in 1939, with no loss of time on account of machine trouble. The chief disadvantage of such a unit is that the tractor cannot be used on other farm work without dismantling and reassembling the equipment. Too much time is involved for the assembling of such a

digger to be done more than once a season.

Strong hitch necessary. The first function of the mechanical digger is to cut loose a furrow of soil large enough to contain all of the sweetpotatoes, then to lift the soil and sweetpotatoes onto the elevator chain. This, being a heavy job, requires that the first work of adapting the commercial potato digger to the sweetpotato crop be the reinforcing of the hitch. Several modified designs of hitches were made and tested in efforts to operate the vine-cutting equipment by attaching it to the hitch directly in front of the digger blade. None of the standard vine-cutting equipment supplied with these diggers was satisfactory for cutting sweetpotato vines. Such designs as did cut the vines required an arrangement which



Figure 62. Oscillating bar type commercial digger.

greatly reduced the maneuverability of the machine. Front trucks in connection with the hitch were found to be unsatisfactory, especially on hilly land. The most satisfactory type of strong hitch was found to be one which provided for the direct

attachment with suitable iron bars to the draw bar of a one-row tractor.

The cutting blades on mechanical diggers are of various sizes and designs. The relative merit of any given blade and its adjustment depend upon specific conditions of digging, and the selection of a type presents problems similar to those encountered in the selection of a plow. Soils which offer resistance to shearing requires a long blade with a gradually curved shape for elevating the furrow slice, while other soils can be handled with shorter blades having a more abrupt slope.

Shaker chains. After the blade has cut loose and lifted the soil mat, the other job for the mechanical digger is to separate the sweetpotatoes from the elevated soil mat. This is done by the shaker chain, but the various soil types and conditions place many requirements upon the chain in service. The sifting action, from the standpoint of design and construction, is regulated by the following: (1) the length of the chain which determines the space or length of time for soil separation; (2) the angle of elevation of the first chain, which determines the amount of soil retarding; (3) the opening between the links of the shaker chain; (4) the degree of chain vibration, as influenced by the design, number, and spacing of the agitating sprockets and rollers; (5) the speed of the chain in relation to the speed of row travel; (6) the use of auxiliary chains, and the distance the sweetpotatoes fall from one to another including the height of discharge from the machine.

Mechanical digger adjustments. The diggers shown in figure 64 are designed so that, with proper adjustments, satisfactory separation of soil and sweetpotatoes can be accomplished. There are both operating and fixed adjustments to be considered. The operating adjustments are of more importance and these are: (1) the accuracy of driving the tractor to center the cutting blade under the hills of sweetpotatoes; (2) the depth of digging; (3) the variation of chain-row speed ratio. The extent of mechanical injuries is

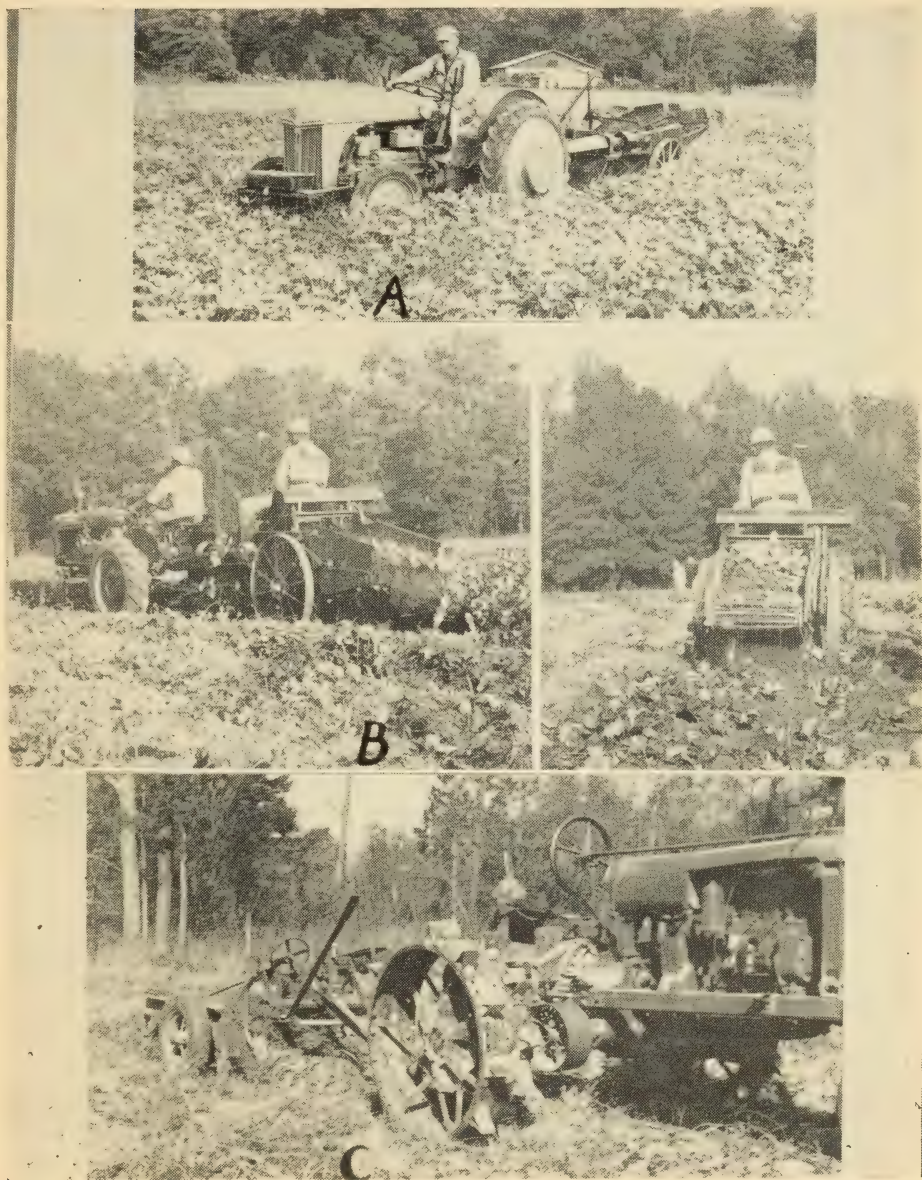


Figure 63. Mechanical rod-link-chain potato diggers, equipped for operation with tractor power. A. Level-bed experimental digger by International Harvester Company. B. International Standard model level-bed digger. C. Chase, without vine-cutting attachments, note choked digger.

not of great importance in harvesting starch sweetpotatoes, but the amount of bruising can be varied by use of these operating adjustments. Sometimes certain

soils may be in such dry, cloddy condition that practically no separation can be satisfactorily accomplished, regardless of operating adjustment. Figure 66 shows a view



Figure 64. Commercial potato diggers of the rod-link-chain type. A. International No. 9, with 1-cylinder engine as power unit. B. John Deere digger with special engine drive.

of a row of hard, cloddy soil, dug with a mechanical digger. Tests in this field resulted in a complete failure to dig with a mechanical digger.

Figure 67 illustrates two typical results of digging in a sweetpotato field, obtain-

ed by varying the operating adjustments of the machine. In "A" of this figure the vines were cut wide, the digger blade was run deeply, and the speed of the chain was slow in relation to the speed of row travel. As shown by the figure, pieces

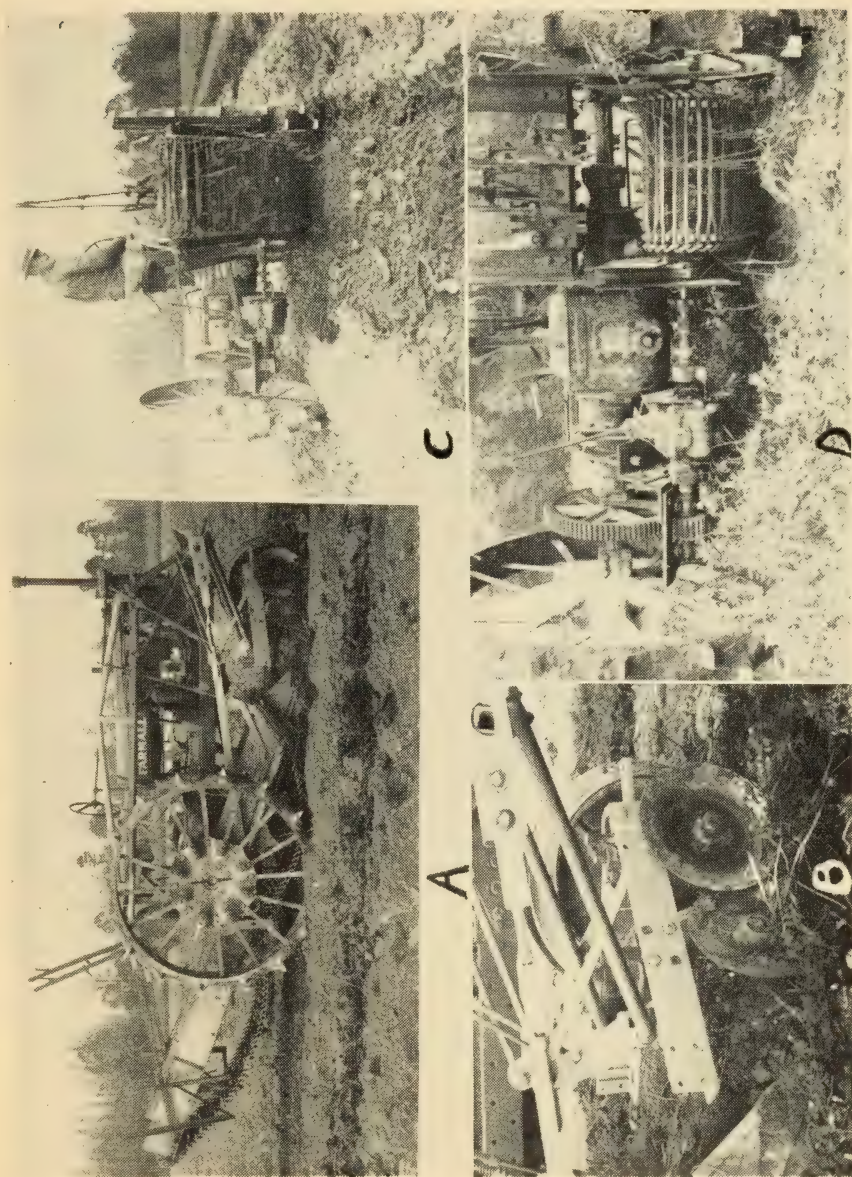


Figure 65. Experimental, direct tractor attached mechanical digger. A. Complete unit. B. Vine-cutting attachment. C. Typical exposure of sweetpotatoes in sandy loam soil. D. Close-up rear view.

of vines and much soil came through the digger together with the sweetpotatoes. The injury to the sweetpotatoes dug in this way is not serious. In "B" of this figure is shown the result of machine oper-

ating adjustment which gives maximum separation of sweetpotatoes. Here, the vines were cut clean from the top of the row, the digger blade was run just deep enough to go under the hills, and the



Figure 66. Kind of work done by mechanical diggers in very cloddy soil.



Figure 67. Work of a mechanical digger adapted for sweetpotato digging. A. Adjusted for wide cutting of vines and deep digging. B. Adjusted for clean cutting of vines and clear view exposure of sweetpotatoes.



Figure 68. Sweetpotatoes showing extent and kind of usual injuries by mechanical digging.

speed of the chain was fast in relation to the row travel. It can be seen that practically all of the crop is exposed on top of the row with the latter adjustment, resulting in easy gathering. Considerable bruising and cutting is certain to be done to the sweetpotatoes when dug in this way, as is shown by figure 68.

Field conditions affect the work of mechanical diggers in harvesting sweetpotatoes, and may be controlled by operating adjustments. Figure 69 shows the work of mechanical diggers under three different field conditions. The field shown at "A" contained a rank growth of weeds, but by proper operation a satisfactory job of digging was done, exposing most of the sweetpotatoes for easy gathering. Here the digger chain had to be operated very fast in order to properly effect the desired separation. The work of the same digger in a field clean of weeds and grass is shown at "B" in this figure, where no special adjustments of operation were necessary for a good job of digging. In the field shown at "C,"

there was a low, poorly-drained area and the poor quality of digging in wet soil is illustrated by the piles of soil seen in the foreground of the picture. In wet soil it is impossible to adjust the operation of a mechanical digger so that satisfactory separation of soil and sweetpotatoes can be done.

The fixed adjustments of a mechanical digger which influence the efficiency of the work performed vary with the design of the different models. All diggers, however, have several types of interchangeable sprockets and rollers which vary the shaking of the chain. The principle that should be kept in mind is that of giving the chain the minimum vibration that is possible and yet obtain the service required in the separation of soil and sweetpotatoes. Excess chain vibration causes unnecessary wear on the machine parts. All machines are provided with different sizes of drive sprockets which are interchangeable, making it possible to vary the ratio of chain speed to row or engine speed. It is possible

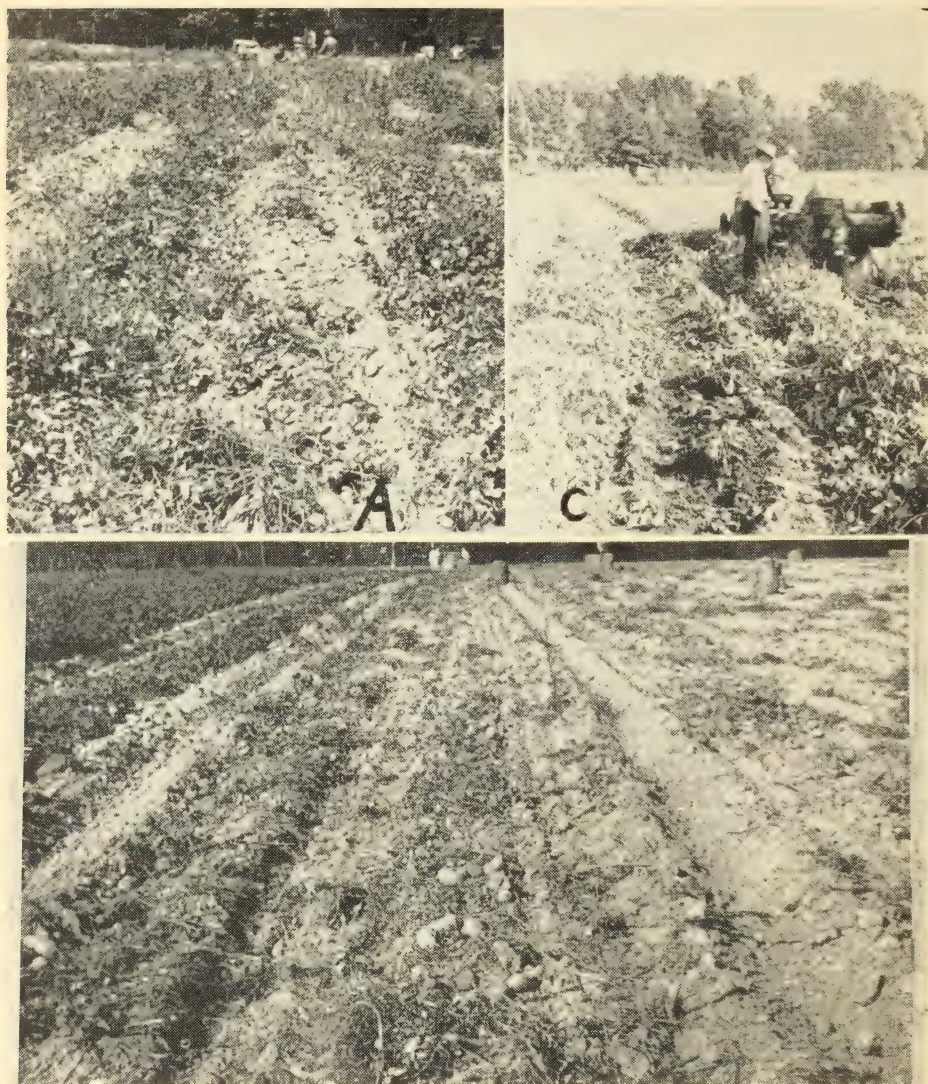


Figure 69. Work of a mechanical sweetpotato digger, under various field and crop conditions. Top, A, weedy patch; Top, C, wet soil; Bottom, clean patch.

also to affect the quality of mechanical harvesting by padding the machine. If one desires to reduce the chances of injury beyond that which is feasible by changes in other adjustments, the rod links of the chain can be covered with pieces of old garden hose or wrapped with strips of canvas or burlap. Canvas can be used to cover the sharp edges in the

path of the chain along the elevator, reducing the chances of bruising the sweetpotatoes.

In evaluating the work of the mechanical digger for sweetpotato harvesting, data were collected on the time required to dig, pick up, heap-row, bag, and crate the crop after digging. It is seen from table 7 that 4.4 man-hours per acre were

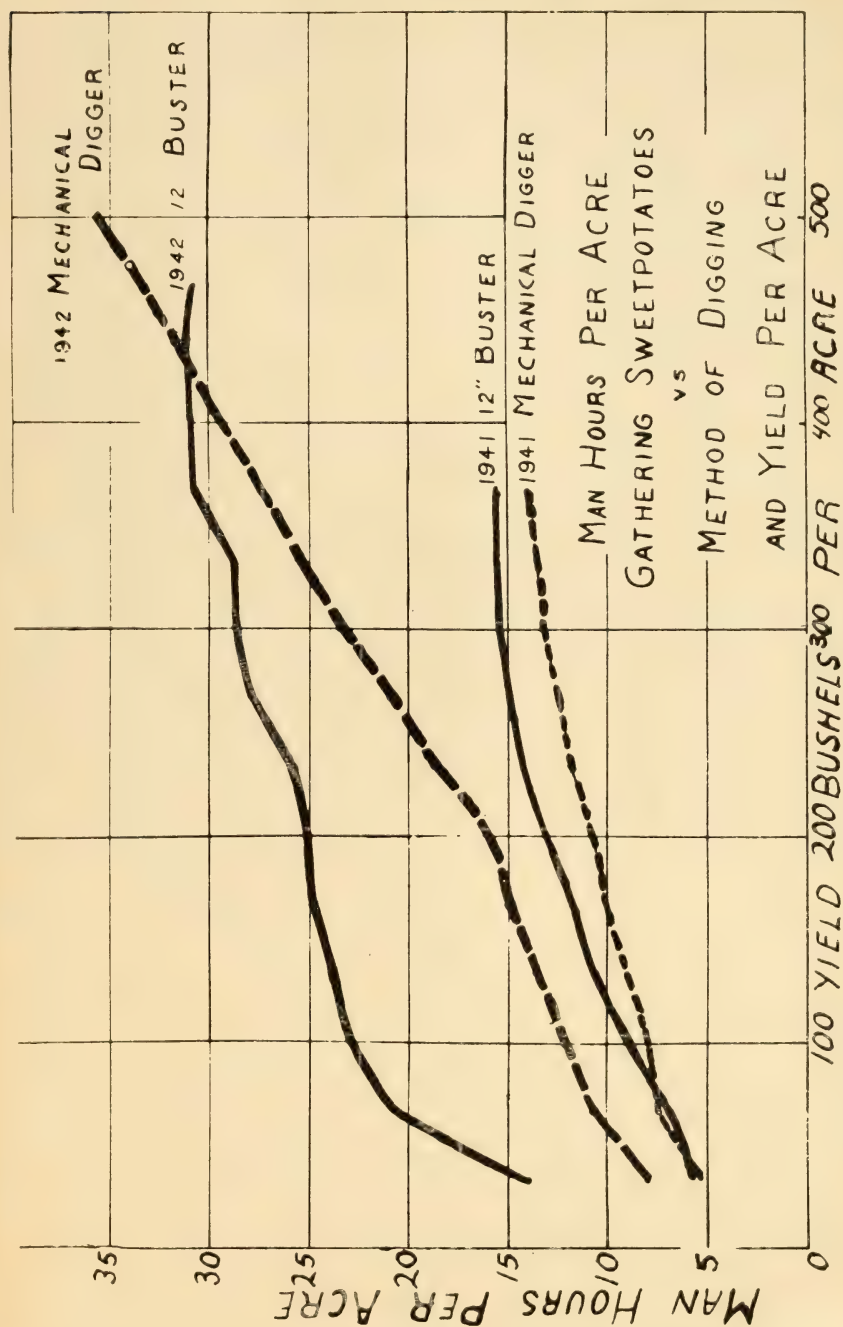


Figure 70. Time required to gather sweetpotatoes after digging with different implements.

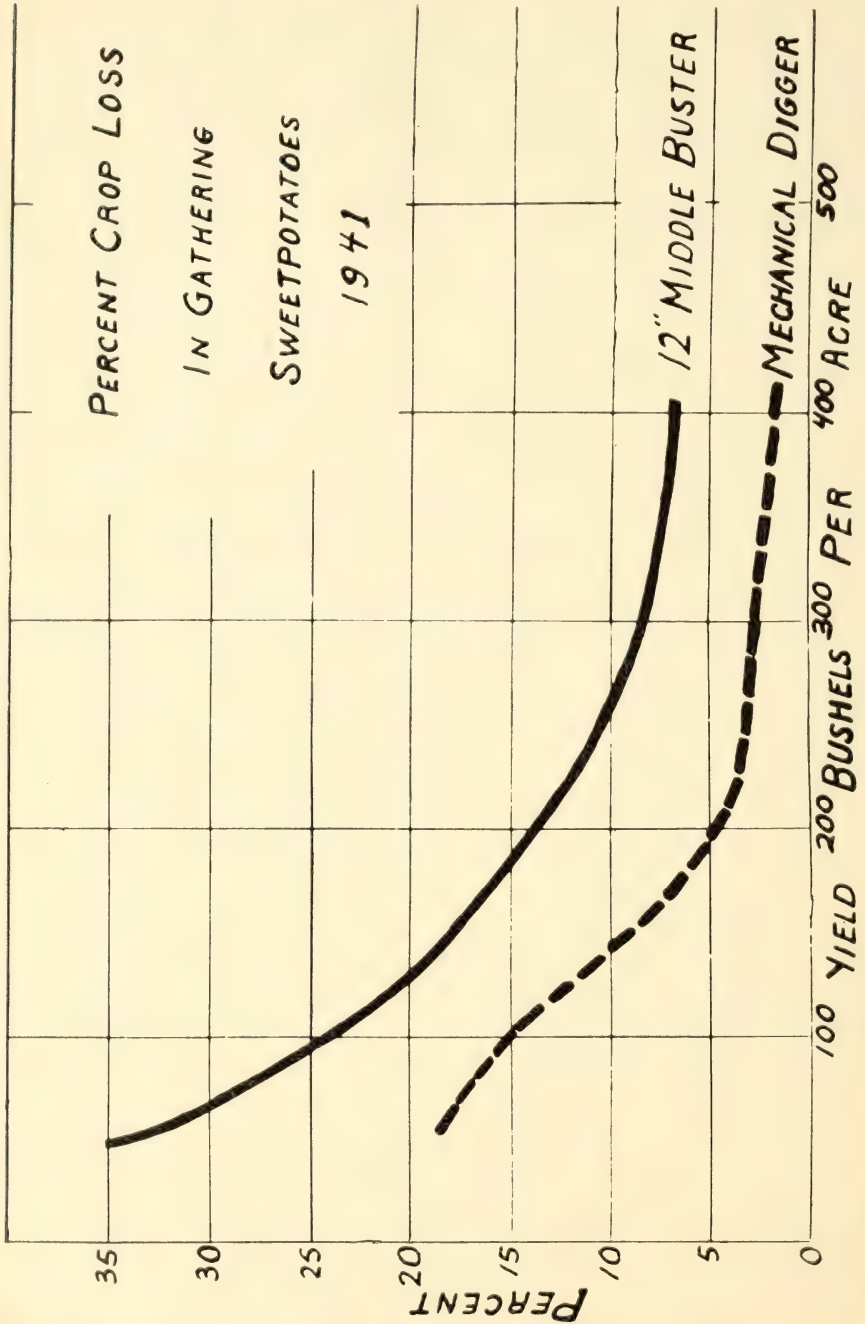
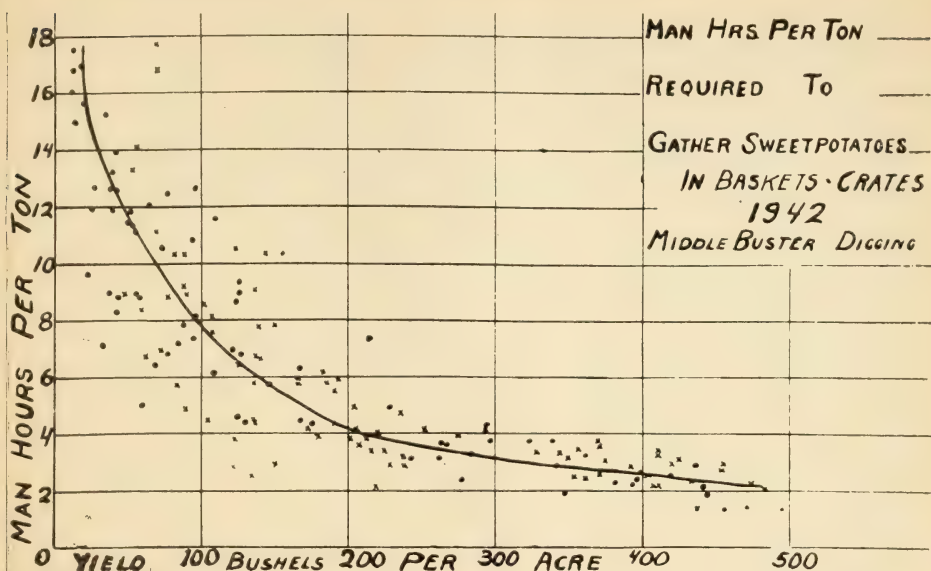
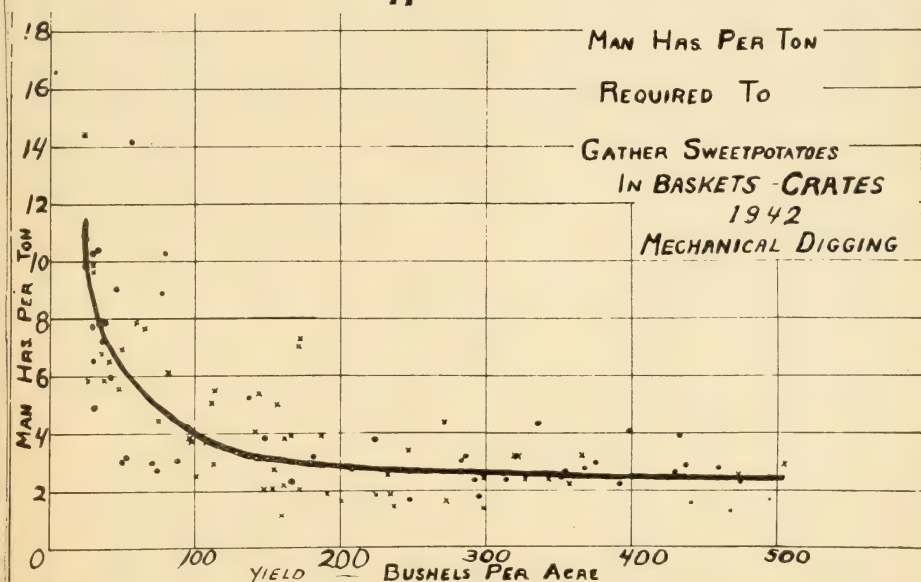


Figure 71. Curves showing crop losses, yield and method of digging.



A



B

Figure 72. Curves showing man-hours per ton required to gather sweetpotatoes of different yields. A. Middlebuster digging. B. Mechanical digging.

required to dig with a mechanical digger equipped with vine-cutters, operated by two men and drawn by a tractor. If no vine-cutters are used, necessitating the

work of two additional men to keep the vines untangled, more than double the time is required to dig an acre. These rates are significantly higher than for the

Table 12.—Time required to collect and sack sweetpotatoes using auxiliary equipment and following different methods of digging.

Method and equipment	No. of cases studied	Man-hours required per ton		
		Maximum	Minimum	Average
Middlebuster and bag sled				
Sweetpotatoes carried in hand	12	10.01	2.49	5.24
Using pails or baskets	74	5.97	.81	2.48
Middlebuster and bag cart				
Using pails or baskets	68	5.71	.81	2.68
Rod-wing middlebuster				
Using bag sled and baskets	71	5.97	.94	2.52
Using bag cart and baskets	63	5.86	.74	2.49
Tractor middlebuster				
Using bag sled and baskets	3	4.92	2.11	3.18
Using bag cart and baskets	23	6.27	.71	2.29
Using bag cart and hands	5	5.87	2.22	3.64
Mechanical digger				
Using bag sled and baskets	136	5.33	.85	2.63
Using bag cart and baskets	190	6.66	.81	2.56

middlebuster type diggers, because of the need for more men to operate the mechanical digger. It should be noted, however, from tables 9, 10, and 11, that the time required to collect, heap-row, and bag after mechanical digging is very much less than that required after the plow and middlebuster types of diggers. Thus for collecting, heap-rowing, and sacking after the common middlebuster, 9.1 man-hours were required; while only 5.22 man-hours were required after mechanical digging. Furthermore, mechanical digging is of particular advantage in the saving of man-hours per acre when inefficient labor must be used for gathering. This is illustrated by the curves in figure 70. The data for the curves shown for 1941 were obtained by using skilled and efficient labor for gathering, and it is seen that there is little difference between the curves for the time required after middlebuster and mechanical digging. Good laborers usually work well in picking up, regardless of the quality of the digging. In 1942 efficient labor was not available, and untrained children had to be used as labor in obtaining the data for the curves shown for that year. It can be seen that the gathering time was very much less, especially at the lower yields, after mechanical digging than after middlebuster digging. In 1941, data were obtained on the proportion of the crop that was not readily found by

good laborers in ordinary inspection along the row after digging with mechanical and middlebuster diggers. The curves in figure 71 show the results of these studies, and they indicate that significantly more losses are likely to occur when digging is done with middlebusters than when done with mechanical diggers. The losses were nearly 20 percent higher at low yields when middlebusters were used than when mechanical diggers were used. The difference was less at higher yields, indicating that sweetpotatoes are more easily exposed to view when higher yields are made.

Factors Influencing Cost of Harvesting

In addition to the implements used for digging, there are other factors which influence the time required; hence, the efficiency and cost of harvesting sweetpotatoes. In connection with the investigations reported herein, it was possible to obtain information about the influence of the quality of labor, yield, and auxiliary equipment for gathering and hauling upon the time required. Data from these studies are shown in tables 12 and 13, and by the curves in figures 70 and 71.

Time required for bagging.—The data in table 12 show the time required in man-hours per ton to collect and bag sweetpotatoes with different equipment following digging by middlebusters and mechanical diggers. When the sweetpotatoes are carried by handfuls to the bags,



Figure 73. Original design of a bagging sled, by Lee Graves, Summerland, Mississippi.

the time required is double that required when they are placed first into pails or baskets and then carried to the bags and emptied. They show that when use is made of such bagging sleds as are illustrated in figures 73, 74, and 75, the man-hours required to bag a ton are not ma-

terially reduced. Neither do they show that there is a savings in bagging time when the carts shown in figure 76 are used to hold the bags. It appears that regardless of how the bags are kept in the field, so long as they are conveniently located, from 2.5 to 3.5 man-hours per

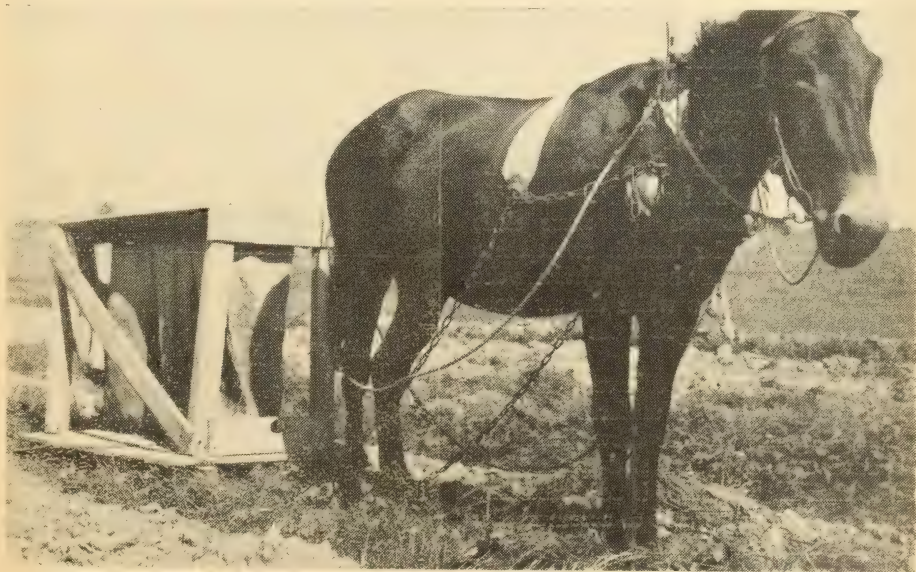


Figure 74. Small bagging sled used by a grower.



Figure 75. Bagging sled designed for use of different size bags by adjusting the height of the frame.

ton are required to bag sweetpotatoes.

The bagging sleds and carts do, however, effect a saving in the total of the harvesting time and reduce the drudgery. They are useful in bunching the filled bags so that the truck or wagon can be more quickly and easily loaded. The bagging sleds may be simply and cheaply constructed, varying in style according to the materials available or in keeping with the needs and special requirements of the grower. They may be large enough to accommodate 3 or 4 bags and be drawn by a two-mule team, or they may be small enough to be handled by a single mule. In any construction, these sleds should be no wider than a sweetpotato row so that they may be pulled along the alternate undug rows while the sweetpotatoes are being bagged from the dug rows on each side.

Growers who do not have an available supply of bags of uniform size will find a sled like the one shown in figure 75 advantageous. This sled was designed so that the top frame is adjustable and can be raised or lowered to accommodate bags of different heights.

The bagging carts, shown in various forms in figure 76, are better bag-carry-

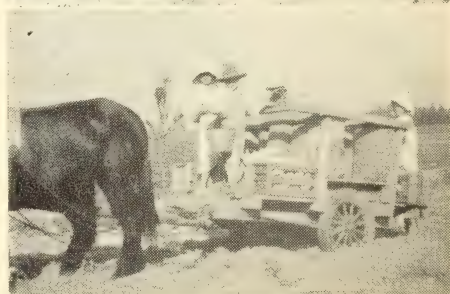


Figure 76. Various forms of bagging carts.

Table 13.—Time required for miscellaneous sweetpotato harvesting operations.

I. Distribution of bags and changing bags on sled or cart			
Method and equipment	Number of cases studied	Average weight	Average man-hours per ton
Bag from heap row	13	105	.47
Three-bag sled	8	80	.72
Eight-bag cart	7	160	.37
Fifteen-bag cart	7	160	.24
II. Loading stake body truck with sweetpotatoes in field			
Method and equipment	Number of cases studied		Average man-hours per ton
Sweetpotatoes in heap-row, loose loaded	10		6.97
In bags scattered over field, middlebuster digging	10		1.02
In 3-bag lots scattered, middlebuster digging	8		.55
In 8- and 15-bag lots scattered, middlebuster digging	3		.46
In bags scattered over field, mechanical digging	10		.82
In 3-bag lots scattered over field, mechanical digging	8		.46
In 8- and 15-bag lots scattered over field, mechanical digging	3		.31
III. Unloading at starch factory in holding bins			
Type of truck and load	Number of cases studied		Average man-hours per ton
Loose load in stake body truck	18		.71
Bag load in stake body truck	21		.45
Loose load in school bus truck	13		1.87
Bag load in school bus truck	12		1.50

ing devices than sleds. They are not difficult to design and construct, and may be made of varying sorts of junk automobile parts available. Bagging carts are capable of carrying more bags with the same team than are sleds. They are sufficiently easy to pull and growers find it convenient to drive to the end of the row, to the edge of the field, or even to a road outside the field if necessary, to assemble the bags for the hauling truck. Like the sleds, carts may be made so that the frames are adjustable and will accommodate bags of different heights.

In section I of table 13, data are presented to show the amount of time required for distribution of bags and changing them on the sleds and carts of different types. These data show that from about one-fourth to three-fourths man-hours per ton of sweetpotatoes are required for the handling of the bags. The amount of time required per ton is inversely proportional to the capacity of the sled or cart, a 15-bag cart requiring .24 and a 3-bag sled .72 man-hours per ton. It is notable that when the weight of the filled bags was less, the time required was not reduced.

Loading and unloading trucks. Other data in table 13 show the time required, under different conditions, to load sweetpotatoes on trucks at the field and unload them at the starch factory. They show that loading time is made much shorter when the bagged sweetpotatoes are assembled in groups of 8- to 15-bag lots as compared to a much scattered condition. If the field has been mechanically dug, and thus is left practically without ridges, the loading time is reduced still more. As might be expected, loose-loading from heap-rows requires excessive amounts of time; nearly 7 man-hours per ton. Unloading bags from a stake body truck at the factory can be done in less time than any other type of load studied.

Gathering efficiency affected by yield. The data in connection with the curves in figures 70, 71, and 72 show that the time required for gathering sweetpotatoes after middlebuster and mechanical digging is greatly affected by the yield per acre. In figure 70, the curves represent the man-hours per acre required for gathering sweetpotatoes of different yields. It will be noted that as the yield goes up,

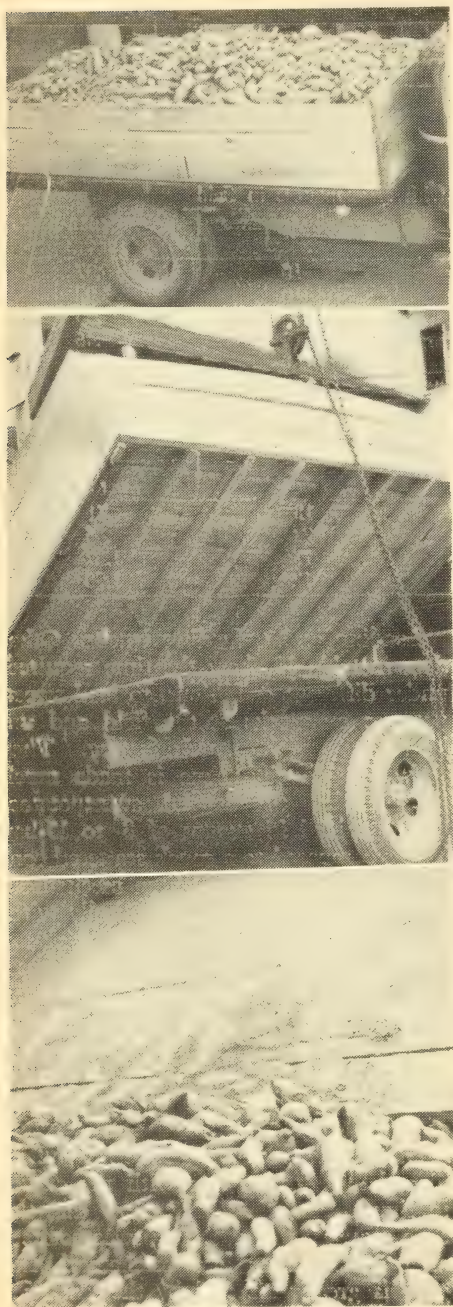


Figure 77. Dump-body on truck being unloaded at starch factory.

the time required per acre is more. In 1941, when efficient labor was employed, the time required ranged from about 5 hours per acre for yields of less than 50 bushels to around 15 hours per acre for yields of approximately 350 bushels. In the 1942 curves, the inefficient labor employed required from nearly 15 hours for the 50-bushel yields to more than 30 hours for 450-bushel yields, when middlebusters were used for digging. When the digging was with the mechanical digger, the time required was lower for the low yields and increased at a slower rate, as the yields increased, than when middlebusters were used for digging.

The curves in figure 72 show the time required per ton to gather sweetpotatoes in baskets or crates from various yields. The curve for mechanical digging shows that the time required per ton is higher for low yields. It decreased rapidly as the yields increased from 50 to 100 bushels per acre, very slowly from 100 to 200 bushels, and remained nearly constant from 200 to 500 bushels per acre. The range is from about 2 man-hours per ton for 500 bushels to nearly 12 man-hours for 50 bushels. For middlebuster digging the curve shows the requirement much higher, reaching nearly 18 man-hours per ton, for yields less than 50 bushels per acre. It decreases rapidly as the yield increases to 200 bushels per acre, but not so rapidly as in the case of mechanical digging. The minimum requirement at the highest yield of nearly 500 bushels is approximately 2 man-hours per ton.

The curves in figure 71 show the percentage of crop losses when varying yields are made. The curves for both types of diggers in the tests are very similar. They show quite definitely that a much lower percentage of the crop will be left in the field if the yields are high. The losses were from 20 to 35 percent of the crop for 50-bushel yields and only 2 to 7 percent when yields were as high as 400 bushels per acre.

Hauling methods. The bag method of transportation of sweetpotatoes was adopted at the Laurel starch factory early be-



Figure 78. Experimental crate cart, and its use illustrated.

cause it seemed to be the most practical method. Used jute or burlap bags were plentiful and cheap at that time. War conditions, however, have developed a

scarcity of heavy used bags as well as a scarcity of man labor to handle them when filled with sweetpotatoes. Other bag materials are either scarce or not



Figure 79. Piling hopper attached to rear of mechanical digger.

strong enough to stand the weight of sweetpotatoes. Advantages are noted in the use of crates for hauling, regardless of their relatively large bulk in relation to capacity.

In an experiment designed to make use of crates for field gathering, tests were

conducted in 1942 of a loose-load dump truck system of hauling starch sweetpotatoes to the factory.*⁷ In this system,

⁷Acknowledgement is hereby made to Dr. F. H. Thurber, United States Southern Regional Research Laboratory, New Orleans, Louisiana, for suggesting this study and making the work possible by active cooperation and participation.

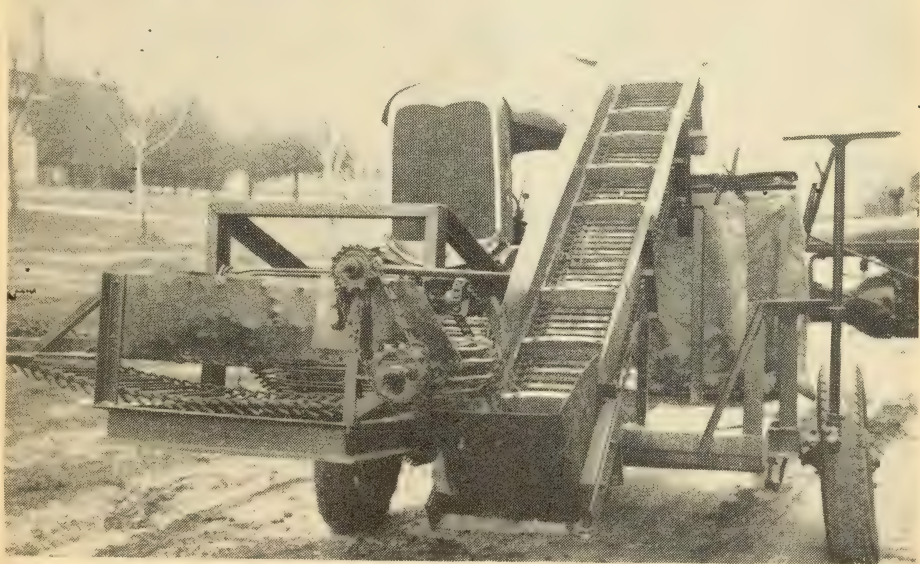
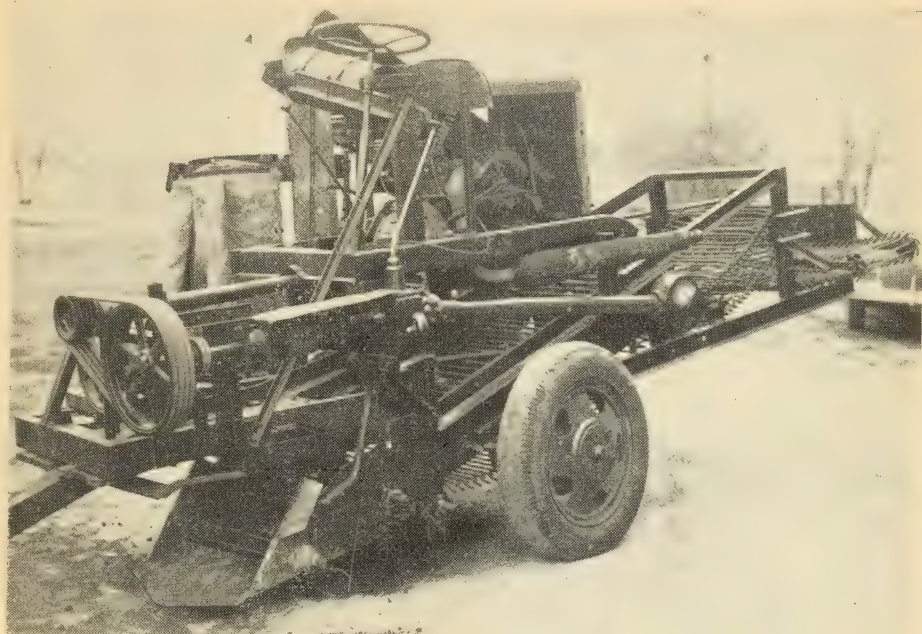


Figure 80. An experimental combined digger and bagger.

field crates are distributed along several dug rows in such number that the sweetpotatoes can be collected and placed in them with virtually the same amount of

labor used in heap-rowing. Then other laborers follow a truck having a special dump body into which the filled crates are dumped, and immediately redistribut-

ed on other adjacent dug and ungathered rows. The special dump body of a 1½-ton truck, used in the experiments, is shown in figure 77. This body can be dumped easily into convenient bins by power mechanisms and thus release considerable man-hours of labor ordinarily used up in unloading heavy bags at the factory. The data obtained on the use of this system indicates much merit in it for cooperative harvesting and low-cost transportation of starch sweetpotatoes. On the basis of harvesting 200 bushels per acre from middlebuster digging, 63.4 man-hours are required by the heap-row and bag system, while only 26.1 man-hours are required if the field crate and dump truck system is used.

In the development of such a system, it is realized that the problem of moving crates and operating a truck about a field is complicated by the differences between row spacings and the tread width of a standard wagon or truck. On this account, one experimental model crate cart has been built with a wheel spacing which

follows the one-row tractor and fits the standard sweetpotato row width. This cart, shown in use in a field in figure 78, has proved to be a very convenient and serviceable unit as an aid in harvesting with crates in standard row fields.

Combine Digging and Loading

The Laurel Starch Plant is designed to handle all sweetpotatoes larger than an inch in diameter and free of foreign matter, but places no limit or penalty on mechanical injuries. The factory is so designed that it can do an excellent job of washing sweetpotatoes, but it cannot satisfactorily handle strings, root crowns, and excessive amounts of dirt. Because of this, tests have been conducted to determine whether the quality of sweetpotato digging can be so controlled by mechanical methods that the product coming from the digger chain is suitable for direct movement to the starch factory. Several mechanical developments are here reported.

The piling hopper shown in figure 79 was the first designed; it has little or no

Table 14.—Weight percentage distribution of material delivered from a mechanical digger in combine harvesting of starch sweetpotatoes.

Soil and machine conditions	Percentage of total as:		
	Sweet-potatoes	Vines and roots	Dirt
Dry sand, no weeds; two sifter chains	92.8	4.8	2.4
Dry sand, crab grass; two sifter chains	72.5	20.9	6.6
Wet sandy loam, few weeds; two sifter chains	34.9	6.3	58.8
Wet sandy loam, crab grass; two sifter chains	20.0	5.1	74.9
Dry clay loam, few weeds; two sifter chains	87.0	4.2	8.8
Moist clay loam, few weeds; two sifter chains	72.8	2.1	25.1
Moist clay loam, crab grass; two sifter chains	69.9	2.7	27.4
Dry clay loam, few weeds; single sifter chain	49.6	4.7	45.7
Moist clay loam, few weeds; single sifter chain	72.0	3.8	24.2
Moist clay loam, crab grass; single sifter chain	56.6	1.8	41.6
Organic soil, all vines removed			
dry; long chain, no shakers	90.4	2.6	7.0
moist; long chain, no shakers	48.2	7.0	44.8
dry; long chain, one pair shakers	94.3	3.2	2.5
moist; long chain, one pair shakers	62.4	2.9	34.7
dry; long chain, two pairs shakers	94.9	3.8	2.3
moist; long chain, two pairs shakers	71.5	3.2	25.3



Figure 81. Illustrating the volume proportions of vines, strings, and sweetpotatoes harvested by combine digging.

advantage, principally due to the fact that the digger failed to give a high degree of soil separation.

A combined digger and bagger as shown in figure 80, has great soil sifting capacity but under the conditions tested, it did not harvest a product acceptable to

the local starch factory. These failures, determined by the requirements of one factory, do not limit the advisability of the further consideration of combine diggers where conditions warrant it. Figure 81 illustrates the quality of digging obtained with this combine digger.

Table 14 shows the percentages of foreign matter contained with sweetpotatoes as harvested under different conditions and use of equipment. The weight of strings and root crowns does not ordinarily indicate their high percentage of the volume of material harvested or how such strings may interfere with a cleaning operation at the factory. The amount of this bulky material might be reduced by special attachments on the digger, or by having enough labor on the

machine to pick out the material as it passes over the last conveyor of the digger.

The combine digger may be of value in the control of sweetpotato pests. It is believed that if all strings, root crowns, and vine pieces could be removed from the land, there would be a reduction in the infestations carried to the next crop. This waste material, while low in starch content, might be suitable for making a livestock feed for local use.



